RouteFinder™

Multi-Protocol Router with 56K DSU

## LAN-to-LAN Routing for Central-Site and Branch Office Networks

# DSU RouteFinder

## Model MTASR2-201

User Guide

MultiTech® Systems

# User Guide

88301701 Revision B
DSU RouteFinder (Model MTASR2-201)



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## Record of Revisions

| Revision | Description |
|---|---|
| **A** (11/3/98) | Manual released; covers software revision 3.00. All pages at revision A. |
| **B** (11/30/99) | Manual revised to show E1 (2.048 Mbps) synchronous capability for WAN link; also added new command cable. All pages at revision B. |

### Patents

This Product is covered by one or more of the following U.S. Patent Numbers: **5.301.274; 5.309.562**; **5.355.365; 5.355.653; 5.452.289; 5.453.986**. Other Patents Pending.

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Multi-Protocol Router with 56K DSU

# Chapter 1 - Introduction and Description

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# Introduction

Welcome to Multi-Tech's new DSU RouteFinder, Model MTASR2-201, which provides secure and seamless LAN-to-LAN routing capability and can also provide dial-up capability. This unit supports multiple WAN services and supports a wide range of routing protocols including IP, IPX, TCP, and RIP version 2. When the WAN 2 port is configured to support it, this unit also supports a secondary capability of dial-up Remote Access Server (RAS) access for telecommuters and mobile users from any Point-to-Point Protocol (PPP) or Serial Line Internet Protocol (SLIP) networking client. Refer to the Chapter 4, DSU RouteFinder Software, and your on-line help system for more details on RAS.

The DSU RouteFinder features a 10Base-T port for local LAN connection, a command port for configuration, a 56K bps DDS 4-wire WAN connection, and an RS232/V.35 port for an optional Data Communications Equipment (DCE) device (i.e., external modem, T1/E1 CSU/DSU, etc.). System management is provided through the command port using bundled Windows® based software which provides easy-to-use configuration menus.

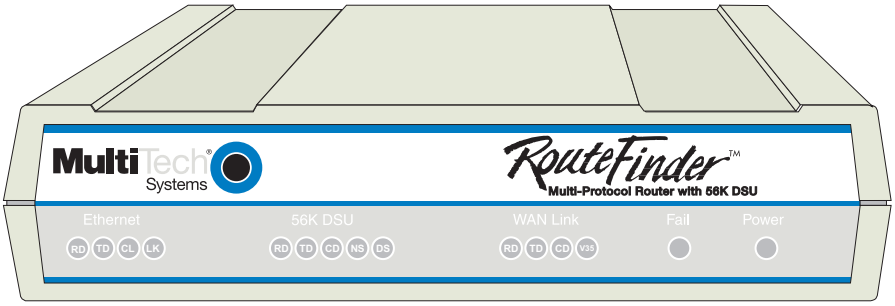


**Figure 1-1. DSU RouteFinder**

* Some DSU RouteFinder units may be marked “MultiRouter” or “MultiRouter 200-Series”; they are equivalent to the “DSU RouteFinder” referred to throughout this user guide.

# Preview of this Guide

This guide describes the DSU RouteFinder and tells you how to install and configure the unit. The information contained in each chapter is as follows:

## Chapter 1 - Introduction and Description

Chapter 1 describes the DSU RouteFinder. Front panel indicators, and back panel connector descriptions are provided. In addition, a list of relevant specifications is provided at the end of the chapter.

## Chapter 2 - Installation

Chapter 2 provides information on unpacking and cabling your DSU RouteFinder. The installation procedure describes each cable connection and shows how to switch the shunt position if the unit is to be used with V.35.

## Chapter 3 - Software Loading and Configuration

Chapter 3 provides instructions for software loading and initial configuration. The DSU RouteFinder software disks are Windows® based. Later chapters, and your on-line help program, describe the DSU RouteFinder software in greater detail.

## Chapter 4 - DSU RouteFinder Software

Chapter 4 describes the DSU RouteFinder software package designed for the Windows® environment. This chapter describes the DSU RouteFinder software from an applications standpoint, and in so doing, not every screen is shown, nor is each field within a screen defined. For explanations and parameters of each field within a dialog box, refer to the on-line help system provided within the software.

## Chapter 5 - Remote Configuration and Management

Chapter 5 provides procedures for changing the configuration of a remote DSU RouteFinder. Remote configuration enables you to change the configuration of a unit by simply connecting two modems between the two DSU RouteFinders and remotely controlling the unit. Chapter 5 also describes typical client applications (i.e., Telnet and Web-based management) used for remote configuration of the DSU RouteFinder.

## Chapter 6 - Warranty, Service and Tech Support

Chapter 6 provides instructions on getting service for your DSU RouteFinder at the factory, a statement of the limited warranty, information about our Internet presence and user bulletin board service, and space for recording information about your DSU RouteFinder prior to calling Multi-Tech's Technical Support group.

# Front Panel Description

The front panel, shown in Figure 1-2, contains four groups of LEDs that provide the status of the Ethernet connection, 56K DSU port, WAN port, and general status of the DSU RouteFinder. The Ethernet LEDs indicate the status of the LAN activity, the 56K DSU LEDs indicate the status of the internal DSU port (WAN 1), and the WAN Link LEDs indicate the status of the external DCE device (WAN 2). There are also two LEDs which indicate whether the self test passed or failed (Fail) and if the power On/Off switch on the back of the DSU RouteFinder is turned On (Power).

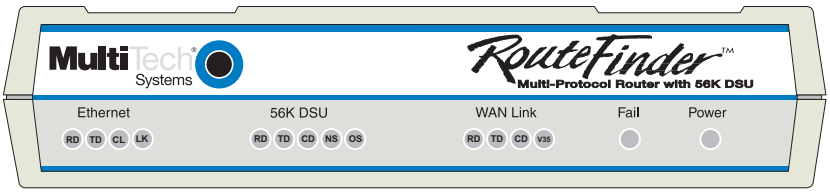


**Figure 1-2. Front Panel**

## Ethernet

**RD** Receive Data indicator blinks when packets are being received from the local area network.

**TD** Transmit Data indicator blinks when packets are being transmitted to the local area network.

**CL** Collision indicator lights when a collision is detected on the Ethernet link.

**LNK** Link indicator lights indicating that the RouteFinder is connected to the local area network.

## 56K DSU

**RD** Receive Data indicator blinks when packets are being received from the wide area network.

**TD** Transmit Data indicator blinks when packets are being transmitted to the wide area network.

**CD** Carrier Detect indicator lights when a carrier signal is detected on the WAN link.

**NS** No Signal indicator lights when the DSU RouteFinder is unable to detect a signal on the DSU (WAN 1) port.

**OS** Out of Service indicator lights when the DSU port is out of service.

## WAN Link

**RD** Receive Data indicator blinks when packets are being received from the wide area network.

**TD** Transmit Data indicator blinks when packets are being transmitted to the wide area network.

**CD** Carrier Detect indicator lights when a carrier signal is detected on the WAN link.

**V35** V.35 indicator lights when internal shunt is set for V.35 operation.

## Fail

The Fail indicator lights for 3 minutes when power is applied to the DSU RouteFinder; if it remains on for over 3 minutes, it indicates that a boot failure has occurred; this indicator also lights when firmware is being downloaded to the DSU RouteFinder.

## Power

The Power indicator lights when power is applied to the DSU RouteFinder.

# Back Panel Description

The cable connections for the DSU RouteFinder are made at the back panel. Connectors include Power, Command Port, 10BASET (Ethernet), 56K DSU and RS232/V.35. The cable connectors are shown in Figure 1-3 and defined in the following groups.

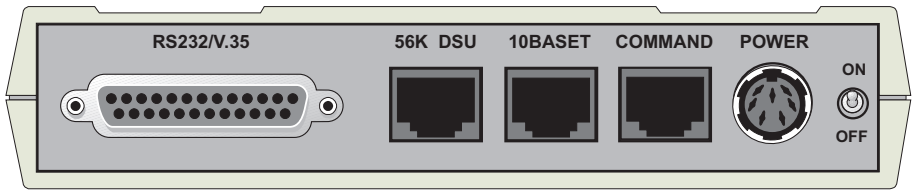


**Figure 1-3. Back Panel**

## RS232/V.35 Connector

The RS232/V.35 (DB-25) connector is used to connect the DSU RouteFinder to an external modem, DSU, or other Data Communications Equipment (DCE). This connection can be either RS232C (default) or V.35. If the connection is V.35, then the shunt must be moved from the default RS232 position to the V.35 position (for details on this procedure, refer to Chapter 2 - V.35 Shunt Procedure).

## 56K DSU Connector

The 56K DSU connector is used to connect the DSU RouteFinder to a Digital Data Service (DDS) network connection. This connector is an RJ-45 jack.

## 10Base-T (Ethernet) Connector

The Ethernet 10Base-T connector is used to connect the DSU RouteFinder to a LAN using unshielded twisted cable. This connector is an RJ-45 jack.

## Command Connector

The Command connector is used to configure the DSU RouteFinder using a PC with an available COM port and running Windows® software. The Command port connector is an RJ-45 jack and an adapter cable is provided to plug into a standard 9-pin COM port on a PC.

## Power Connector

The Power connector is used to connect the external power supply to the DSU RouteFinder. The Power connector is a 6-pin circular DIN connector. A separate power cord is connected to the power supply and the live AC grounded outlet.

# Related Documentation

The complete documentation package for the DSU RouteFinder includes this User Guide, a Quick Start Guide, and a Remote Access Server Dial-Out Redirector User Guide. The printed version of the Quick Start Guide, shipped with the unit, provides the necessary information for a qualified person to unpack, cable, load software, and configure the unit for proper operation. The Dial-Out Redirector User Guide is for those who need communications connectivity for their Windows or DOS dial-out or fax-out programs. Copies of the guides are provided on the Manuals disk that ships with each DSU RouteFinder unit, and you can always find the latest version of these guides at Multi-Tech's Web site.

At the Multi-Tech Home Page (http://www.multitech.com), click Support, then Manuals, then DSU RouteFinder and you will find the DSU RouteFinder User Guide and the Remote Access Server Dial-Out Redirector User Guide.

# Safety Warning Telecom

1. Never install phone wiring during a lightning storm.
2. Never install phone jacks in wet locations unless the jacks are specifically designed for wet locations.
3. This product is to be used with UL and cUL listed computers.
4. Never touch uninsulated phone wires or terminals unless the phone line has been disconnected at the network interface.
5. Use caution when installing or modifying phone lines.
6. Avoid using a phone (other than a cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.
7. Do not use the phone to report a gas leak in the viciniity of the leak.

# Specifications

- Routing Protocols - IP and IPX and Bridging all others
- Protocols - Point-To-Point Protocol (PPP) and Serial Line Internet Protocol (SLIP)
- Two 1 Meg by 32 byte, 70 nanosecond SIMMs (8 Mb DRAM, total)
  **Caution:** SIMM speed and size cannot be mixed
- One Meg of flash memory

## Ethernet Port

- Single Ethernet Interface - 10Base-T (twisted pair) RJ-45 jack

## 56K DSU Port

- Single 56K bps DDS 4-wire RJ-45 jack

## Command Port

- Single 19.2 Kbps asynchronous Command Port using a short RJ-45 to DB-25 cable with a DB-25 female connector

## WAN Link

- One 115200 bps async or T1/E1 (1.544/2.048 Mbps) sync link using a DB-25 (RS232/V.35) female connector

## Electrical/Physical

- Voltage - 115 VAC (Standard), 240 Volts AC (Optional)
- Frequency - 47 to 63 Hz
- Power Consumption - 10 Watts
- Dimensions - 1.625" high x 6" wide x 9" deep

  5.63 cm high x 22.34 cm wide x 33.51 cm deep
- Weight - 2 pounds (.92 kg)

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# Chapter 2 - Installation

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# Safety Warnings

1. Never install telephone wiring during a lightning storm.
2. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
3. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
4. Use caution when installing or modifying telephone lines.
5. Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.
6. Do not use the telephone to report a gas leak in the vicinity of the leak.

# Unpacking your DSU RouteFinder

The shipping box contains the DSU RouteFinder, external power supply, a plastic bag containing cables, your Quick Start Guide, and three diskettes (i.e., the DSU RouteFinder User Guide, and the DSU RouteFinder Software). Inspect the contents for signs of any shipping damage. If damage is observed, do not power up the unit, contact Multi-Tech's Technical Support for advice (refer to Chapter 6 - Warranty, Service and Tech Support). If no damage is observed, place the DSU RouteFinder in its final location and perform the Cabling Procedure.

Save the shipping box (Figure 2-1) in case reshipment is necessary.

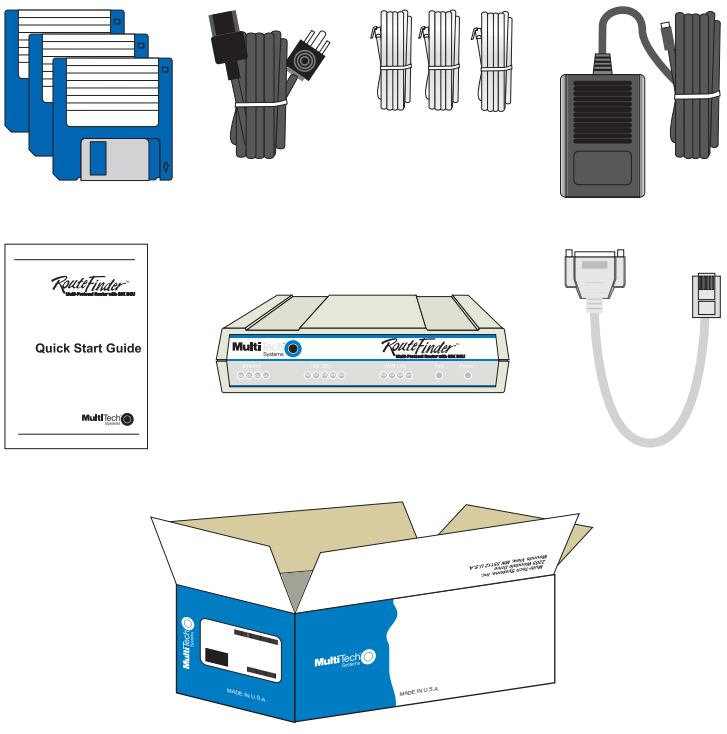


**Figure 2-1. Unpacking**

# 8-Position DIP Switch

The DSU RouteFinder is equipped with an 8-position DIP switch. Figure 2-2 shows the DIP switch, and the chart that follows details the default positions and other options.

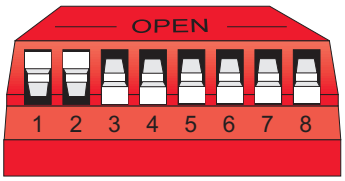


**Figure 2-2. 8-position DIP switch**

| | | |
|---|---|---|
| **Position 1:** | OPEN* (up) | Normal Mode operation |
| | Closed (down) | Loopback Mode operation |
| **Position 2:** | OPEN* (up) | DDS clocking |
| | Closed (down) | Internal Clocking |
| **Positions 3 - 8:** | | Reserved for future use. |

* Denotes Factory Default setting

**Note:** The DIP switch settings cannot be changed externally; you must remove the circuit board from the chassis. Refer to the steps in the next section, V.35 Shunt Procedure, for instructions on removing the circuit board.

# V.35 Shunt Procedure

If you are using an external DCE device on the WAN 2 RS232/V.35 port, and the connection will be a V.35 connection, the internal shunt must be moved from the RS232C (default) position prior to cabling and power-up. The following steps detail the procedures for switching the shunt.

**Step** **Procedure**

1 Ensure that the external power supply is disconnected from the DSU RouteFinder.

2 Turn the DSU RouteFinder over and remove the cabinet mounting screw (Figure 2-3) from the chassis.

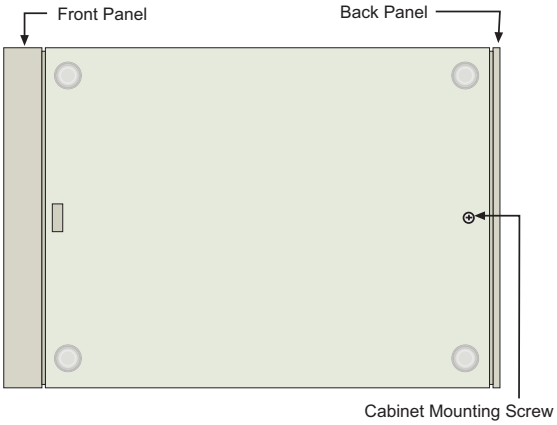


**Figure 2-3. Cabinet Mounting Screw Location**

3 While supporting the back panel, turn the DSU RouteFinder right side up, tilt the back panel down, and slide the circuit board out of the chassis.

4 Place the unit on a flat, grounded surface.

5 Pry the shunt out of the RS232 position, and insert it in the V.35 position. See Figure 2-4.

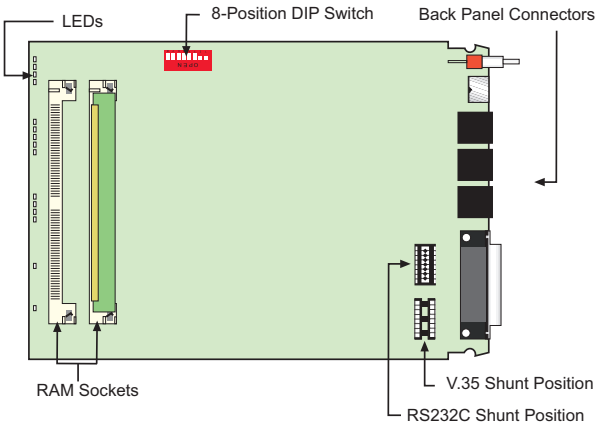


**Figure 2-4. Shunt Positions**

**Note:** if you wish to make changes to the 8-position DIP switch, do so at this time. For details on DIP switch settings, refer to the previous section, 8-Position DIP Switch.

6 Align the board with the guide slots on the inside of the chassis and carefully slide the board back into the chassis.

7 While supporting the back panel, turn the DSU RouteFinder over again, and replace the cabinet mounting screw.

8 Turn the DSU RouteFinder right side up again and proceed to the next section to connect the cables.

# Cabling Your DSU RouteFinder

Cabling your DSU RouteFinder involves making the proper Power, Command Port, Ethernet and 56K DSU connections. An optional WAN connection is provided to connect to an external WAN device. Figure 2-5 shows the back panel connectors and the associated cable connections.

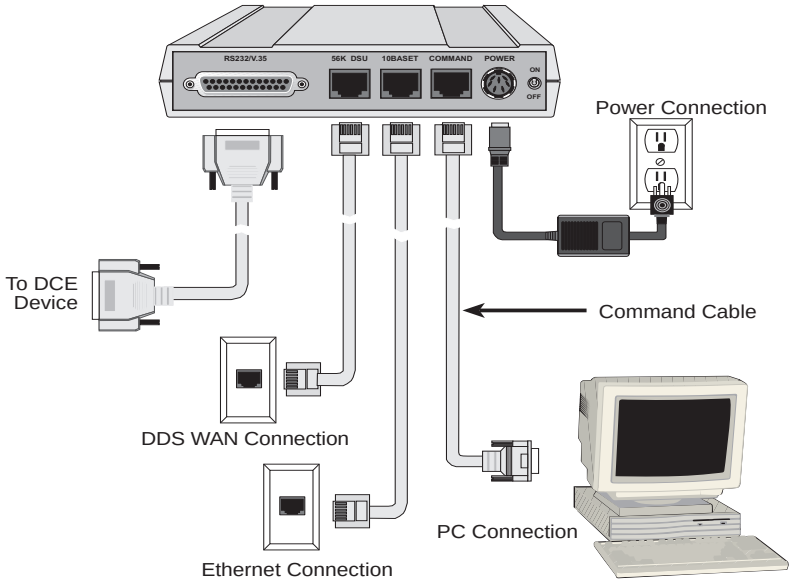


**Figure 2-5. Cable Connections**

The following steps detail the procedures for connecting the cables to your DSU RouteFinder.

1. Connect one end of the power supply to a live AC outlet and connect the other end to the DSU RouteFinder as shown in Figure 2-5. The power connector is a 6-pin circular DIN connector.
2. Connect the DSU RouteFinder to a PC using the RJ-45 to DB-9 (female) cable provided with your unit. Plug the RJ-45 end of the cable into the Command port of the DSU RouteFinder and the other end into the PC's COM port. See Figure 2-5.
3. Connect a network cable to the ETHERNET 10BASET connector on the back panel of the DSU RouteFinder. Connect the other end of the cable to your network.
4. Connect one end of an RJ-45 cable to the 56K DSU connector on the back of the DSU RouteFinder. Connect the other end to your Digital Data Service (DDS) WAN connection.
5. If you plan to use the optional RS232 port for dial backup, connect one end of an RS232 cable to the RS232/V.35 connector on the back panel of the DSU RouteFinder and connect the other end of the cable to an external DCE device such as a modem or T1/E1 CSU/DSU.
6. Turn on power to the DSU RouteFinder by setting the ON/OFF switch to the ON position. **Wait** for the FAIL LED on the DSU RouteFinder to go OFF before proceeding. This may take a couple of minutes to go OFF.

At this time your DSU RouteFinder is completely cabled. Proceed to Chapter 3 - Software Loading and Configuration, to load the RouteFinder software.

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# Chapter 3 - Software Loading and Configuration

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# Introduction

The following loading procedure does not provide every screen or option in the process of installing the DSU RouteFinder software. It is assumed that a technical person with a thorough knowledge of Windows and the software loading process is doing the installation.

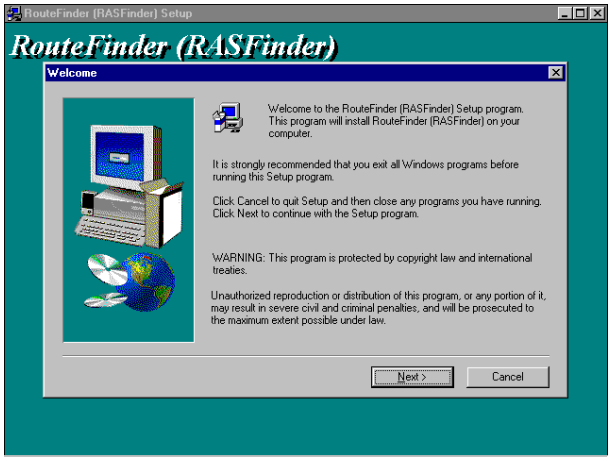
# Loading Your Software

1 Run Windows on the PC that is connected to the DSU RouteFinder's Command Port.

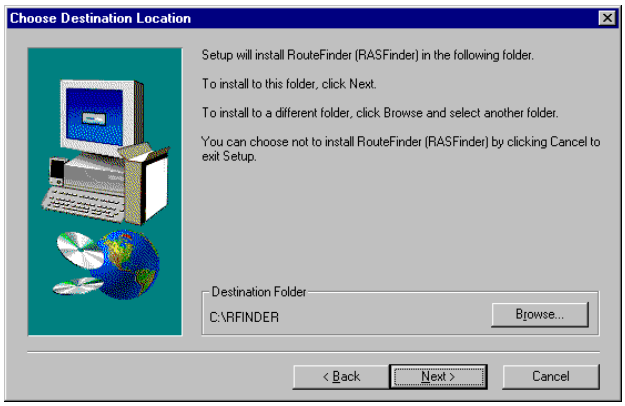
2 Insert the RouteFinder **Disk 1** into the disk drive on the PC that is connected to the DSU RouteFinder.

3 **Win3.1 users** - in the Program Manager, access Run by clicking **File | Run**. In the Run dialog box, type **a:\setup.exe** or **b:\setup.exe** (depending on the letter of your floppy disk drive) in the Command Line field and then click **OK**.

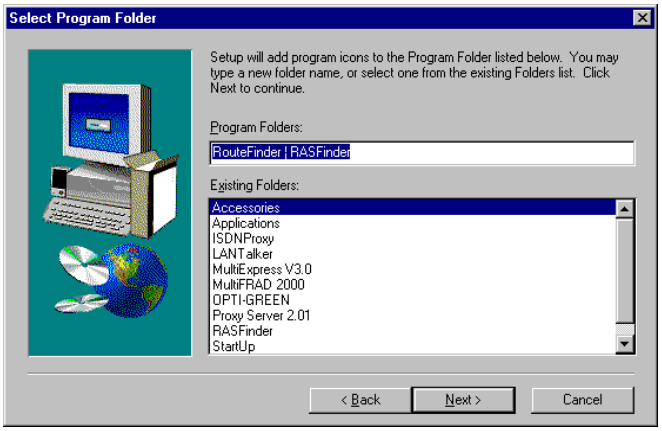
**Win95/98/NT users** - click **Start | Run**. In the Run dialog box click the down arrow and choose **a:\setup** or **b:\setup** (depending on the letter of your floppy disk drive), then click **OK**.




4 When the **Welcome** screen appears, press **Enter** or click **Next>** to continue.

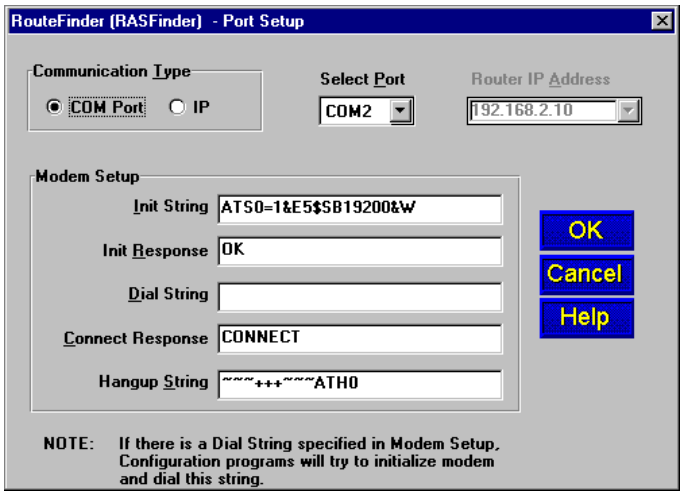



5 Press **Enter** or click **Next>** to continue.

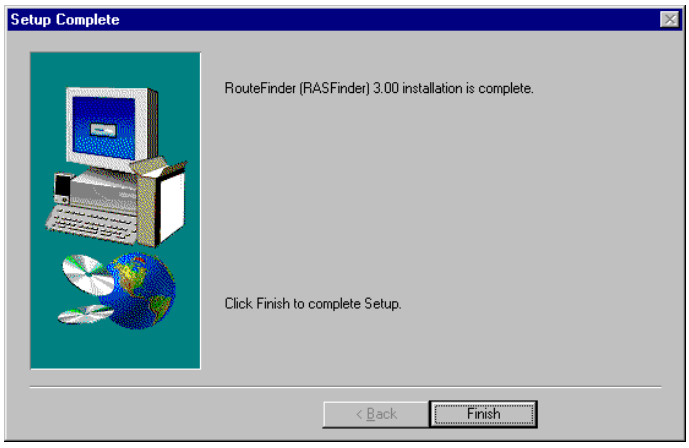



6 When the **Select Program Folder** dialog box appears, click (to the right of the text) on the **Program Folders** text box, then backspace through "| RASFinder" until the cursor is next to the letter "r" in "RouteFinder"; this will become the name of the program group. Press **Enter** or click **Next>** to continue.

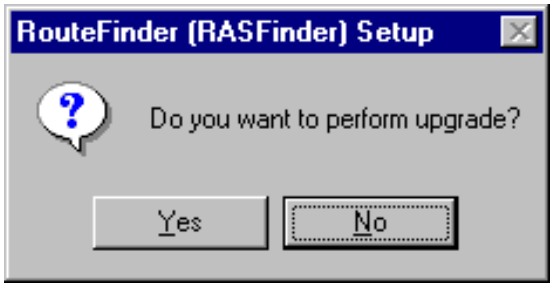
7 The next dialog box enables you to designate the COM port of the PC that is connected to the DSU RouteFinder. On the **Select Port** field, click the down arrow and choose the COM port of your PC (COM1 -- COM4) that is connected to the DSU RouteFinder.




8 Click **OK** to continue.



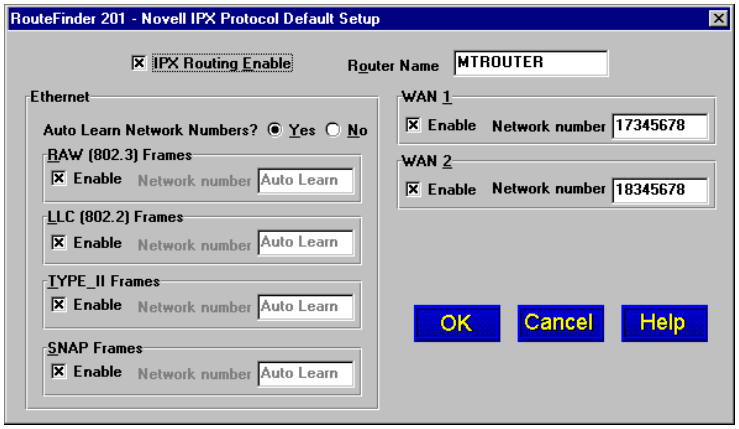

9 Click **Finish** to continue. The "**Do you want to perform upgrade?**" dialog box is displayed.




10 Click **No** to skip the upgrade process. The "**Do you want to download default setup?**" dialog box appears.


11. Click **Yes** to download the default setup. (Clicking on **No** prevents you from setting up the defaults and downloading them to the DSU RouteFinder; instead, you are returned to the program manager, where in Windows 95/98/NT you will see a window with shortcut icons for all the various utility programs in the software.)
12. The **Novell IPX Protocol Default Setup** dialog box appears.

    **Note:** To configure your DSU RouteFinder, you now will use a series of dialog boxes -- **Novell IPX Protocol Default Setup**, **IP Protocol Default Setup**, and **WAN Ports Default Setup**.




13. If your network protocol is **IPX,** continue with the following steps. However, if your network protocol is **IP**, click the **IPX Routing Enable** check box to *disable* IPX, then click **OK** and proceed to step 18.
14. **Router Name:** If this is the only DSU RouteFinder on your network, you can use the default Router Name (MTROUTER); otherwise, you must assign a new Router Name in this field. The Router Name can be any printable ASCII string of up to 47 characters. The DSU RouteFinder uses this name to advertise its service in the IPX internetwork.
15. **Ethernet:** You can enable **Auto Learn Ethernet Network Numbers** by leaving the default (**Yes**) checked, or you can manually assign the network numbers after disabling the Auto Learn option by clicking on **No**. If no file server is connected to the Ethernet segment, then

you should select No.

If you leave Auto Learn enabled, the DSU RouteFinder will learn the IPX network numbers from the file server.

If you disable Auto Learn, record in the space below the network numbers assigned by the network file server for each of the four frame types [(Raw (802.3), LLC (802.2), EthernetII (Type II), SNAP]. You can also record here the Network numbers for WAN 1 and WAN 2.

**RAW** (802.3) Frames Network Number _____

**LLC** (802.2) Frames Network Number _____

**TYPE_II** Frames Network Number _____

**SNAP** Frames Network Number _____

**WAN 1** Network Number _____

**WAN 2** Network Number _____

When you manually assign network numbers, make sure they match the network numbers assigned to your local file server (if any).

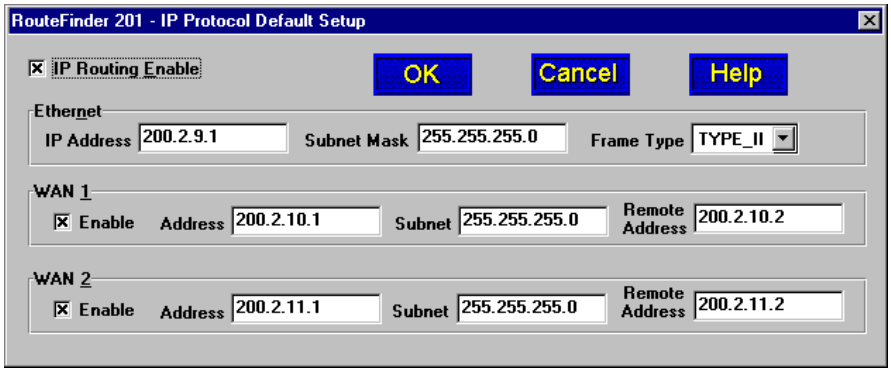
16. **WAN1 and WAN 2**: Click the associated check box if one or the other is to be disabled; otherwise, leave **Enable** checked and double-click the **Network number** text box and enter the WAN Network number.

    The WAN network numbers have to be assigned by the network administrator and must be unique throughout the entire internetwork.

    **Note:** The WAN ports do not have the capability of learning the network number, unlike the LAN port (i.e., the WAN ports do not have a file server).

17. Click **OK** when you are satisfied with your selections.

18. If you clicked **OK** from the Novell IPX Protocol Default Setup dialog box (step 13), the **IP Protocol Default Setup** dialog box is displayed.

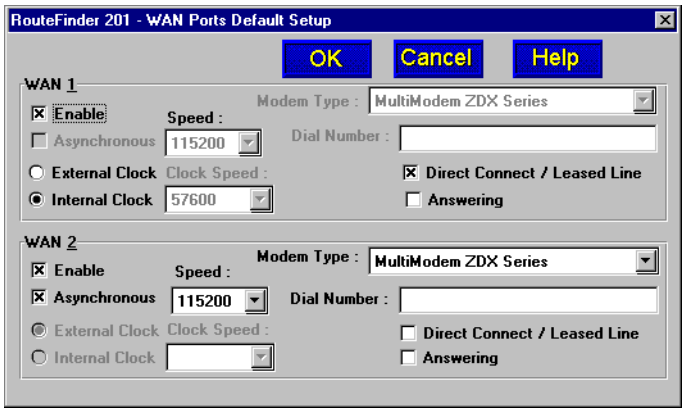



19. To change the IP parameters, proceed to the next step. Otherwise, click **OK** to open the **WAN Ports Default Setup** dialog box, then advance to step 23.

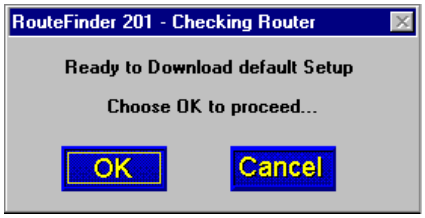
20. The default Ethernet IP Address has to be changed to your unique LAN address. In the **Ethernet** group, change the default **IP Address**, **Subnet Mask**, and **Frame Type** to the values assigned to your LAN port.

21. Click **OK** when you are satisfied with your selections.

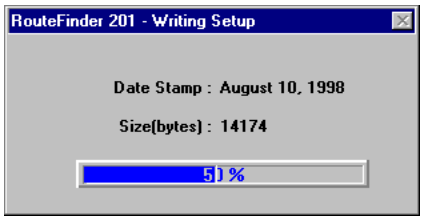
22. The **WAN Ports Default Setup** dialog box appears with both WAN Ports enabled. Note: the External/Internal Clock for WAN 1 is selected on the 8-position DIP switch on the circuit board (External or DDS Clocking is the default). If WAN 1 is not on a Direct Connection or Leased Line, click that option to disable it, then enter your ISP's phone number in the **Dial Number** field.



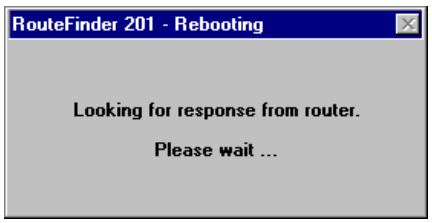

23. Set up all the parameters in the WAN 2 group. Select the modem type from the pull-down list; for a synchronous connection, click the **Asynchronous** option to disable it; for dial-out operation, enter the (ISP) phone number in the **Dial Number** field, or click the **Answering** option if WAN 2 will be used to answer dial-in calls from remote locations.
24. Click **OK** when you are satisfied with your selections.
25. The **Checking Router** dialog box is displayed. Click **OK**.




The **Writing Setup** dialog box (with the current date and the file size in bytes) is displayed as the software sends the configuration file to the DSU RouteFinder.




The **Rebooting** dialog box is displayed.




26. Check to ensure that the **Fail** LED on the DSU RouteFinder goes Off after the download is complete and the DSU RouteFinder is rebooted (the **Rebooting** dialog box goes away).
27. **Win3.1 users** - you are returned to your Program Manager where the RouteFinder Program Group and Program Items (RouteFinder icons) have been created.

    **Win95/98/NT users** - you are returned to your desktop.

Your DSU RouteFinder is operational at this time.

RouteFinder™

Multi-Protocol Router with 56K DSU

# Chapter 4 - DSU RouteFinder Software

MultiTech® Systems

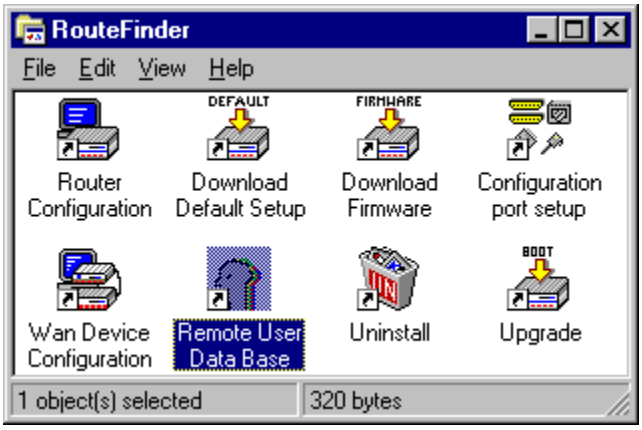
# Introduction

This chapter describes the DSU RouteFinder software from an applications standpoint, showing how to make changes in the configuration with recommendations on the impact of any such changes. The major configuration parameters were set when the software was loaded into your PC and the setup configuration was downloaded to the DSU RouteFinder at the conclusion of the software installation. The DSU RouteFinder software is designed for the Microsoft ® Windows ® environment.

Recommendations are provided to explain that changing parameters may affect your unit in a certain way. Our intent is not to cover every dialog box and every option because the on-line Help system provides that information. The Help menus define each button, option, field, and provide recommend values where applicable. This constitutes a dynamic help system in that the information presented always relates to the dialog box or window that is currently open.

# Before You Begin

Your RouteFinder program group contains several applications which provide the maximum flexibility for configuration and use. These utilities are accessible in Windows by clicking **Start | Programs | RouteFinder | *(utility)***. The various options include Configuration port setup, Download Default Setup, Download Firmware, Router Configuration, Remote User Data Base, Uninstall RouteFinder Configuration and Wan Device Configuration.




RouteFinder Configuration will be discussed in detail later in this chapter. A brief description of the other components is provided here:


## Download Firmware

This utility allows you to download the firmware to the DSU RouteFinder. This may be necessary in the case of repair or upgrade. To download the firmware, choose **Download Firmware** from the RouteFinder program group, and the **Open** dialog box is displayed (if the DSU RouteFinder is running, you will be queried to reboot to update firmware; click **OK** to proceed and the **Open** dialog will be displayed).

By default, the software will display the proper firmware from the RouteFinder folder. Double-click this file in the **File Name** list.

The Downloading Code dialog is displayed, which includes a status bar to monitor the download. When the download is complete the DSU RouteFinder will reboot. This process will take several minutes. After rebooting, you will be returned to Windows.


## Configuration Port Setup

The Configuration Port Setup utility allows you to set up and configure the command port on your DSU RouteFinder. This dialog is included in the initial installation process. Although parameters can be changed, be sure to note the current status of the software before making any alterations.

When you installed the DSU RouteFinder software, you selected to configure the port as either an IP or COM Port. When COM Port is selected, you can assign the proper COM Port and define the modem Init String, Dial String, and various responses. If IP is selected, you can assign a static IP address or select an address from the drop down list. For more information on individual parameters, refer to the on-line help provided with the software.


## Download Default Setup

This feature allows you to download the default settings, configured during installation, to the DSU RouteFinder. If you are installing the software for the first time, you will download the default setup at the end of the installation before operating the DSU RouteFinder. If you have changed the Router Configuration and now want to revert to the default setup, you can do so through the RouteFinder program group.

Choose **Download Default Setup** to download the factory default settings. If the DSU RouteFinder is running, you will be queried to reboot. Click **Yes** to continue with the download. You will then be presented with three dialog boxes including **Novell IPX Protocol Default Setup, IP Protocol Default Setup,** and **WAN Ports Default Setup**. These screens will contain the original setup information. Click **OK** on each to accept the default settings, or make any necessary changes and then click **OK**. When prompted, click **OK** again to proceed with the download. The default setup will be written to the DSU RouteFinder. This process may take a few minutes. When it is finished, you will be returned to Windows.


## Remote User Data Base

This utility allows you to gather information about your remote users. You can add and remove remote users from the data base, or edit information regarding remote users already in the data base.

Choose **Remote User Data Base** from the RouteFinder program group, and the **RouteFinder 201 Users List** dialog box will appear. From this dialog box you can choose Add, Edit or Delete. When you have completed all the necessary changes, click **Download** to save the new information to the DSU RouteFinder. Refer to your online help for a more detailed description of parameters with the data base.


## Uninstall

Selecting Uninstall will allow you to completely remove all the components of the RouteFinder program group. Upon selecting this option your will be queried for confirmation. Click **Yes** to continue with the uninstall, or click **No** to abort.

**Note:** You will not be able to use the DSU RouteFinder without Router Configuration. If you remove the components, you will need to reinstall the software. Refer to your *DSU RouteFinder Quick Start Guide* for installation instructions.


## WAN Device Configuration

If you have an external device connected to the WAN 2 port of the DSU RouteFinder, this application will open the Router Print Console screen, part of a terminal emulation program, that will enable you to configure the external device.

# Setup Menu

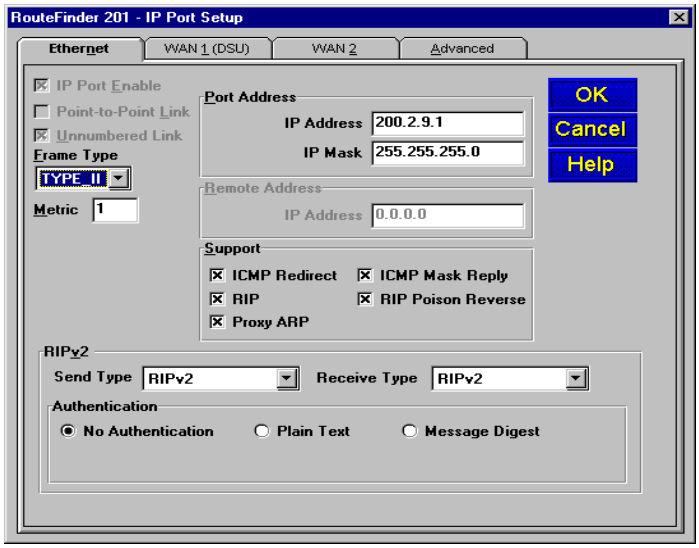

To view or change your RouteFinder configuration in Windows 95/98/NT, click **Start** | **Programs** | **RouteFinder/RASFinder** | **Router Configuration**, or double-click the Router Configuration icon in the RouteFinder/RASFinder program group. After loading, the **DSU RouteFinder Setup** menu will appear.


The DSU RouteFinder Setup menu has 13 buttons (two rows of five buttons plus one row with three buttons) that enable you to display and change the protocol stacks, define the output of the DSU RouteFinder, perform network management functions, test the communications link, print messages received from the target DSU RouteFinder, and download setup information to the DSU RouteFinder.

Two buttons in the bottom row of buttons open the online Help system (Router Help) and end (Exit) a DSU RouteFinder Setup session. The Retry button remains inactive until you fail to connect with the target DSU RouteFinder.

# IP Setup

The **IP Port Setup** dialog box allows you change the IP routing capabilities that were established during the software installation. This dialog box contains four tabs: Ethernet, WAN 1 (DSU), WAN 2, and Advanced.




The Unnumbered Link option can be selected (checked) for the WAN ports for point-to-point links. When selected, it disables the Port Address and Remote Address groups. Unnumbered links are useful only between two routers; in this case, local and remote. When running RIP over a PPP link, both ends of the link must be either unnumbered or numbered with the same IP subnet. An advantage of not assigning an IP address to each WAN port is that you conserve valuable network and subnet numbers.

The Remote IP Address defines the IP address for the destination end of a point-to-point link and is necessary only of the selected WAN port has been enabled for point-to-point operation. Note: the remote IP address must fall within the same IP network as the local IP address.

The Frame Type option defines the MAC layer frame encapsulation to be used for IP transmissions from the specified port. The Ethernet port supports Type II and SNAP frames, but the WAN ports support only Type II frames.

In the **Support** group, **ICMP Redirect** defines if the specified port is permitted to issue an ICMP Redirect message to the source IP address. The most likely cause of this message is the delivery of a datagram to a router that is not on the forwarding path to the destination address. This is often due to a wrong configuration of the IP client sending the datagram. The packet causing the ICMP Redirect message to be transmitted is forwarded to the appropriate router.

**ICMP Mask Reply** enables support for nodes on the connected networks to learn their subnet masks.

**RIP** enables RIP based routing on the specified port, and is normally enabled. However, RIP can be disabled if you are using WAN links in Dial-on-Demand mode. In such links, disabling RIP will reduce traffic on the link as this will also disable periodic RIP broadcasts. RIP routing on the port will be automatically turned off when Dial-on-Demand is enabled in PPP port setup.

Finally, the **RIP Poisoned Reverse** option defines if Poisoned Reverse RIP messages are supported on the specified port. Generation and processing of poisoned routes (RIP entries with their respective metric set to 16 (defined as infinity) is enabled/disabled by this parameter. Poisoned reverse is a method used by RIP to improve the rate of convergence of the routing tables of interconnected IP routers. Routers supporting poisoned reverse that receive such RIPs ignore the entries set to 16 and thus prevent the propagation of unnecessary (and often incorrect

when a topology change occurs) information which in turn speeds up the rate at which RIP will correctly map the current network topology.

The **Ethernet**, **WAN 1 (DSU)** and **WAN 2** tabs allow you to configure parameters for the selected port. Although these tabs all contain the same option groups, certain parameters may be inactive or disabled (grayed-out) when they do not apply to the selected port.

RIPv2 packet setup is accomplished at the bottom of the three port tabs. The **RIPv2** group enables you to set up the send and receive packet types as either RIPv2 (default), RIPv1 Compatible, or None. You can also set up RIPv2 authentication here.

RIP-based routing is normally enabled (checked) but is turned off automatically if the WAN links are set up for dial-on-demand operation.

A brief description of the RIPv2 group is provided in the following section. For details on other parameters, refer to the online Help provided with your RouteFinder software.

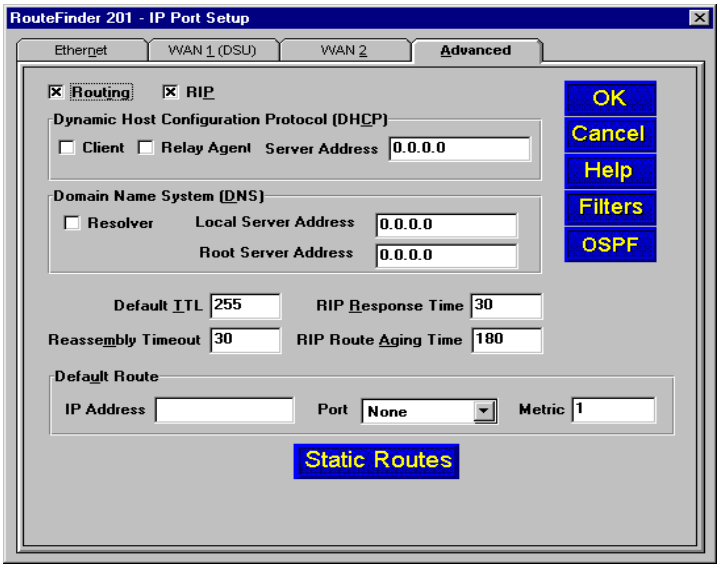
## Routing Information Protocol, Version 2 (RIPv2)

RIPv2 has enhanced “explicit” netmask information and supports several new features including external route tags, subnet masks, next-hop addresses, and authentication. Subnet mask information makes RIP more useful in a variety of environments and allows the use of variable subnet masks on the network. Support for next-hop addresses permits the optimization of routes in an environment that uses multiple routing protocols. For example, when RIPv2 is being run on a network along with another IGP, and one router is running both protocols, then that router can indicate to the other RIPv2 routers that a better next-hop than itself exists for a given destination.

The **Authentication** group is the RIPv2 mechanism for authenticating the sender of the routing eliminates the vulnerability of the routing infrastructure. This authentication scheme is essentially the same mechanism provided by OSPF. Currently, only a plain-text password is defined for authentication.

For Plain Text RIPv2 authentication, the maximum length of the password is 16 characters; however, Message Digest authentication can have a key id field of up to 50 characters.

The **Advanced** tab controls the timers, Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS) servers, the default route, filters, OSPF (Open Shortest Path First), and Static Routes.




The IP Port Setup **Advanced tab** enables you to set up various configuration options for the IP routing protocol. The options that you select here apply to all ports on which IP routing takes place.

The **Routing** option is normally checked; however, if you do not wish to have IP packets routed, then uncheck this item. If IP routing is disabled and bridging is enabled, IP packets are bridged; i.e., IP packets are transferred.

The **RIP** option enables RIP based routing. RIP (Routing Information Protocol) is a protocol used among routers to exchange routing table information. RIP is the most common protocol used in both IP and IPX networks. It is also used internally by client workstations in IPX networks to obtain routes (shortest, or otherwise) to any distant network. RIP based routing should normally be enabled. It can be disabled, however, if you are using WAN links in Dial on Demand mode. For DOD links, disabling RIP will reduce traffic on the link as it will also disable periodic RIP broadcasts. RIP routing on a given port will be automatically turned off when Dial on Demand is enabled on the PPP Port Setup tab for the WAN port.

The **Dynamic Host Configuration Protocol (DHCP)** group enables you to set up the WAN ports as client-only. Then, a PPP client connected to the WAN port will be on the same IP network as the LAN port of the DSU RouteFinder. This feature can save some extra IP addresses that otherwise would have been taken up by the WAN port. Enabling the Client option allows the DSU RouteFinder to dynamically get an IP address for a PPP client coming up on one of its “Client-only” WAN ports. When this option is enabled, there must be a DHCP server or a DHCP relay agent on the connected LAN in order for the DSU RouteFinder to acquire an appropriate IP address.

This option applies only to Client-only WAN ports.

If there is no DHCP server on the LAN segment of the DSU RouteFinder, the **Relay Agent** option must be enabled so the DSU RouteFinder can relay the DHCP packets between clients on the directly connected networks ( i.e., clients on the LAN and the PPP clients that are calling-in on client-only WAN ports) and the server. If the **Relay Agent** option is enabled, the IP address of the DHCP server (dotted decimal format) must be entered in the **Server Address** field.

The DSU RouteFinder supports Domain Name System (DNS) for the terminal server application. This is a built-in Telnet client that can connect a call coming in on a WAN port from a Telnet host. When a user dials into the system to get connected to a Telnet server, the DSU RouteFinder will prompt for a Telnet host address. The user can then either type in the dotted decimal IP address or the domain name of the host.

The **Domain Name System (DNS)** group includes a check box where you can enable DNS Resolver. It also has text boxes where you can enter (in dotted decimal format) the IP addresses of the local DNS server and a “Root” DNS server to be used should the local DNS server fail to respond.

The **Default TTL** text box defines the IP Time-To-Live parameter that sets the maximum number of hops a frame may travel before being dropped. This is used to limit errant frames such as those that may arise under circularly defined networks. Recommended value is decimal 255.

The **RIP Response Time** text box defines the time interval between periodic RIP broadcasts. Regular RIP broadcasts are required to keep the routing tables of all routers in the internetwork consistent. Increasing the frequency of these broadcasts may consume precious bandwidth that could have been used for transfer of other regular packets and has a recommended value of 30 seconds.

The **Reassembly Timeout** text box defines the amount of time the IP routing software will wait for all the fragments of an IP datagram to arrive before discarding the partially reassembled datagram and has a recommended value of 30 seconds.

The **RIP Route Aging Time** text box defines the time interval that must expire before an unused route entry created by RIP is aged from the route table. The aging timer starts from the addition, reference, or change of an RIP based routed entry and has a recommended value of 180 seconds.

The **Default Route** group defines the default route for the DSU RouteFinder. The IP Address field

specifies the full 32-bit IP host address of the next hop for packets being forwarded via default routing. The router will automatically resolve the IP address to a port number via its IP route table. The Metric defines the number of hops to the specified IP address and is typically set to a value of 1. If the default route is for an unnumbered link, select the port from the **Port** combo box. Finally, whenever you set up default routing, be sure to disable RIP based routing.

The **Static Routes** button displays a dialog box that enables you to view, add, edit, or delete static routes to a target IP address (which can be the address of an IP host, an IP network, or an IP subnetwork). You must specify the target host IP address and the Gateway Address in dotted decimal form. The Gateway Address is the IP address of the router that is the next hop toward the target host. The address mask is the subnet mask of the target IP host, and the Metric is the hop count to the target host or subnet and can be either 0 or 1.

In most cases, you should not have to change any of the timers (i.e., default TTL, reassembly timeout, RIP response time and RIP route aging time). The DNS Resolver is supplied for remote Telnet clients when the router is configured for remote access and the terminal server application is enabled.

A brief description of OSPF is provided in the following section. For more details on filtering, refer to the Filtering section of this chapter. For details on other parameters, refer to the online help provided with your RouteFinder software.

## Open Shortest Path First (OSPF)

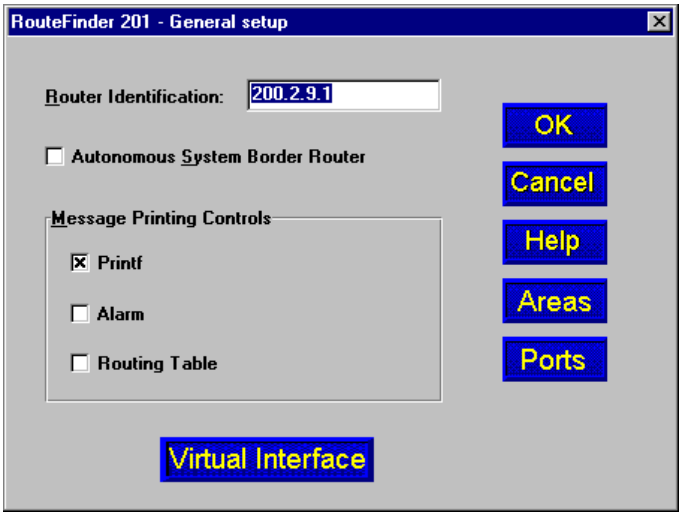
Open Shortest Path First (OSPF) is a common TCP/IP routing protocol that provides robust and efficient routing support in the most demanding Internet environments. OSPF calculates routes using the number of routers, the transmission speed, expected delays, and the cost of the route. Version 2 of the OSPF protocol is designed to be run internal to a single Autonomous System. Each OSPF router maintains an identical database describing the topology of the Autonomous System. From this database, a routing table is calculated by constructing a “shortest-path” tree.

OSPF recalculates routes quickly in the event of topological changes, using a minimum of routing protocol traffic.

Under OSPF, networks can be grouped together into “areas,” each of which is the generalization of an IP subnetted network. The topology of an area is hidden from the rest of the Autonomous System, and this information hiding enables a significant reduction in routing traffic. Also, routing within an area is determined only by the area’s own topology, protecting the area from “bad” routing data.

All OSPF protocol exchanges are authenticated; i.e., only trusted routers can participate in the Autonomous System’s routing. Furthermore, a variety of authentication schemes can be used; in fact, separate authentication schemes can be configured for each IP subnet.

Clicking **OSPF** on the **Advanced** tab opens the **General Setup** dialog box.




This dialog box allows you to set up the DSU RouteFinder as an Autonomous System Border Router; also included here are the message printing controls and buttons that open Area Setup and OSPF Port Setup dialog boxes.

Selecting Autonomous System Border Router enables the DSU RouteFinder as an AS (Autonomous System) border router, capable of exchanging routing information with routers in other Autonomous Systems. The AS border router then advertises external routes throughout its Autonomous system.

Items in the **Message Printing Controls** group are generally left unselected (unchecked) to maintain a high level of router performance. The Routing Table refers to the tables internal to each IP or IPX router on the network that maintain information on how to reach known networks and the cost (or hop) of reaching the network. The routing table has information that specifies the outgoing port a packet should be put on to reach the destination network addressed in the packet. Routers use some protocol (usually RIP) to broadcast their routing tables on the internetwork. Routers receiving such broadcasts, update their tables to construct and maintain a full picture of all networks on the internetwork of LANs.

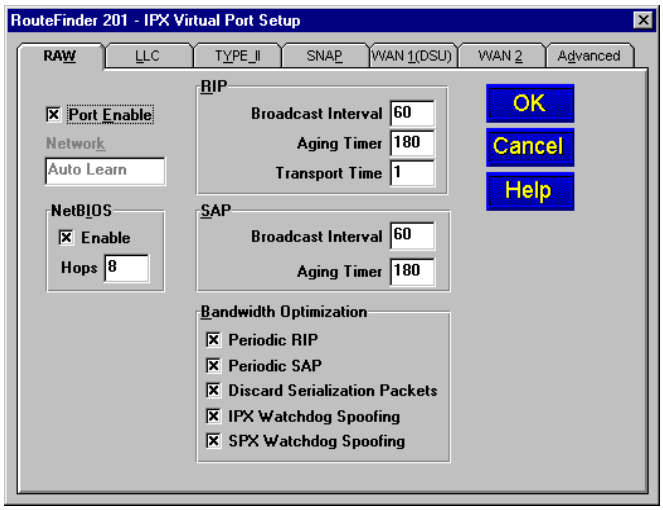
The **Areas** button opens a dialog box that enables you to configure various parameters for OSPF areas. For example, you can add or delete areas or edit the parameters for an existing area. An Area ID does not have to coincide with an IP address or an IP network ID; however, the Area ID 0.0.0.0 is reserved for the backbone. If the area represents a subnetted network, the IP network number of the subnetted network can be used for the Area ID. Areas can be designated as Stub Areas, in which case Autonomous System external advertisements will not be flooded into or through them. Furthermore, if the DSU RouteFinder is a border router to the stub area, the stub metric indicates the cost of the default summary link that the Routefinder advertises into the area.

The **Ports** button opens an **OSPF Port Setup** dialog box that enables you to enter various parameters related to the ports. Examples include the Area ID for the area to which the port is connected, the router Priority, the Cost of sending a packet out of the port, Transmit and Retransmit delays, and the Dead Interval. For further information, refer to the on-line Help.

The **Virtual Interface** button opens a **Virtual Interfaces** dialog box where you can add, delete, or edit virtual interfaces. Virtual Interface entries will consist of Transit Area ID numbers and Virtual Neighbor Router ID numbers; the Transmit Delay, Hello Interval, Retransmit Interval, and Dead Interval (all, in seconds) can be specified, and Authentication keys and Key IDs can be used.

# IPX Setup

The **IPX Virtual Port Setup** dialog box is used to control the four frame types and set up the two WAN ports of the DSU RouteFinder. The Advanced tab is used to enable or disable IPX routing and auto learn of Ethernet network numbers; also, the distributed name of the DSU RouteFinder can be designated or changed here.




In IPX based networks using Ethernet, LAN segments can support the use of four different Ethernet frame formats over the same physical link (provided each frame type has a unique network address as a virtual port).

NetBIOS, when enabled, enables the transport of Novell encapsulated NetBIOS packets on the specified virtual IPX port. Refer to Novell documentation regarding NetBIOS operation over NetWare based LANs. The Hops text box defines the distance, in hops, for the routing of Novell encapsulated NetBIOS frames on the specified virtual IPX port, and the recommended value is 8.

Periodic RIP (Routing Information Protocol) refers to broadcasts transmitted from the RIP virtual IPX port at a given frequency so all routers on the internetwork maintain consistent routing tables. Increasing the frequency of RIP broadcasts can consume excessive bandwidth, especially on low-speed WAN links. Sixty seconds is the recommended interval between RIP broadcasts.

Periodic SAP (Service Advertisement Protocol) is used in IPX based networks to allow servers (application servers, file servers, print servers, communication servers, etc.) to advertise their presence on the internetwork. Routers use these advertisements to build up tables listing the servers so they can then advertise these servers on the local segments and provide routers to the server. Client workstations can request a list of these servers from the router.

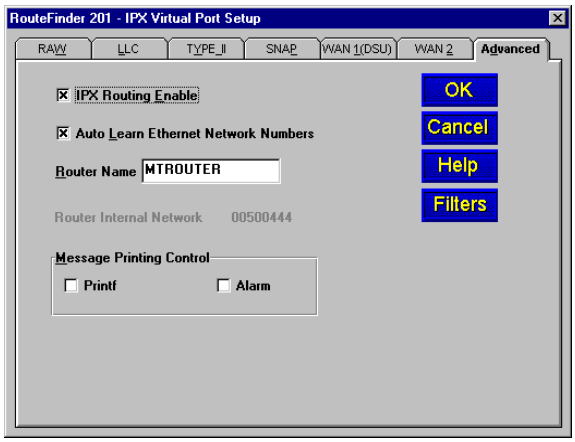
Discard Serialization Packets, when enabled (checked), causes the IPX router to discard Novell NetWare File Server serialization security frames received from the specified virtual IPX port. Novell NetWare File Servers implement broadcast frames, often referred to as security frames, that contain serialization information regarding the license of the file server executable. This feature permits filtering of these broadcasts to help reduce WAN traffic and is not intended to interfere with copyright protection mechanisms. This feature is automatically turned on when Dial-On-Demand is enabled in PPP port setup.

The default RIP and SAP timer settings should work for most applications. Under certain circumstances, disabling IPX and SPX Watchdog Spoofing in the Bandwidth Optimization group has proven effective.

The two IPX WAN Setup dialog boxes allow you to enable or disable IPX routing on the WAN ports, change the network numbers for the WAN ports, change the default RIP and SAP timers, and optimize the bandwidth. The IPX WAN network number has to be the same on both ends of

the link and must be unique throughout the internetwork. If a WAN port is configured in a point-to-point operation, both WAN network numbers have to be the same and unique.

The Advanced tab controls the master routing of the protocol and auto learn of Ethernet network numbers, defines the broadcast name of the DSU RouteFinder, and enables IPX filtering.

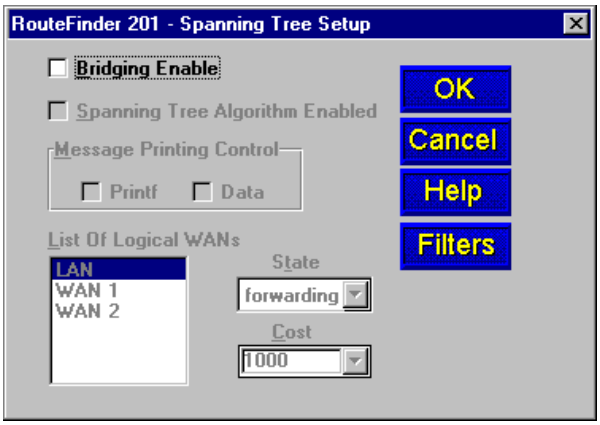



If bridging of IPX packets is desired, IPX routing must be disabled and frame type support for the frame type must be enabled.

If there is a server on the local segment, then IPX network number auto learn should be enabled. If there is no server, or if for some reason the DSU RouteFinder comes up before the server does, the DSU RouteFinder will default to some random network numbers after a short period of time.

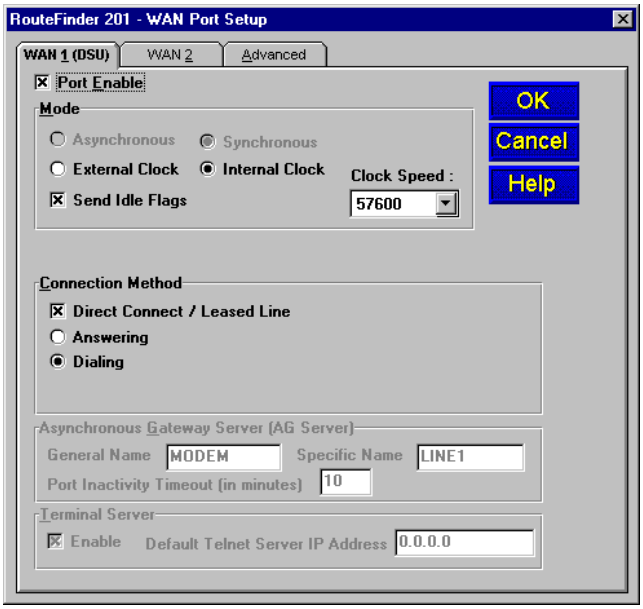
# Spanning Tree Setup

When Bridging is enabled, the **Spanning Tree Setup** dialog box controls simple transparent bridging between two remote Ethernet LANs. However, if your internetwork contains any loops or redundant links, then the Spanning Tree Algorithm must also be enabled. If you use only the IP and IPX protocols, leave bridging disabled to allow the DSU RouteFinder to operate more efficiently.

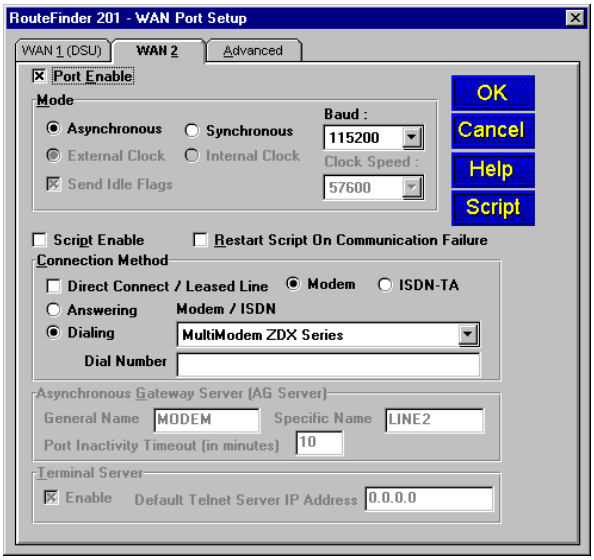


# WAN Port Setup

The WAN Port Setup dialog box lets you set up the wide area network (WAN) port options for the DSU RouteFinder's two WAN ports (WAN 1 and WAN 2), each of which has a separate tab. The default connection method for WAN 1 is Direct Connect / Leased Line, with the clock mode set to external (DDS) clocking, unless the switch setting on the 8-position DIP switch on the circuit board has been changed. Synchronous mode cannot be changed; however, the default clock speed setting of 57600 bps can be changed as necessary (drop-down list). Send Idle Flags is checked to indicate that the DSU RouteFinder will send idle flags on the synchronous WAN link whenever it is idle.

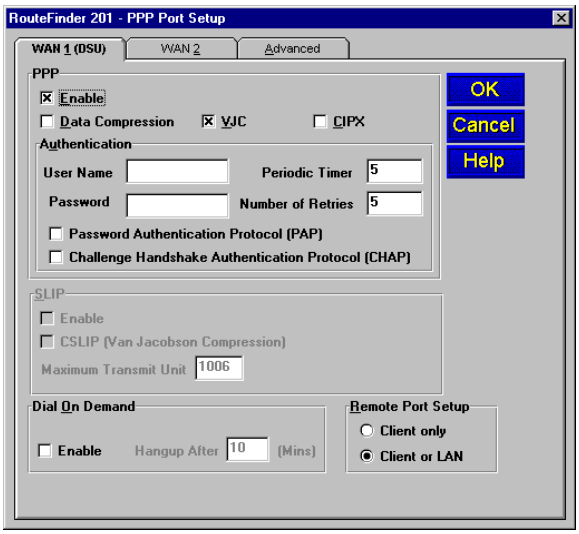



Three connection methods are available for WAN 2: either Direct Connect / Leased Line, Modem, or ISDN-TA. WAN 2 defaults to a Modem connection, and you can select another modem from the drop-down list if you don't happen to be connected to a MultiModem ZDX Series modem. If this is the dialing end of a dial-up link, you will need to enter the phone number to be dialed in the Dial Number text box in the **Connection Method** group.



# PPP Port Setup

The **PPP Port Setup** dialog box controls the WAN port protocol, dial on demand, and remote port setup. The WAN port protocol can be either Point-to-Point Protocol (PPP) or Serial Line Internet Protocol (SLIP). Of these two protocols, PPP is the more robust as it allows the endpoints to negotiate the use of the link and protocol parameters in a standardized way and also allows for standardized encapsulation of the packets. SLIP is an older protocol which requires manual authentication using a script.




PPP is the default protocol. The PPP software in the DSU RouteFinder internally negotiates the use of a suitable authentication protocol (PAP or CHAP) with the remote router or remote access client software. When either PAP or CHAP (or both) is enabled, the DSU RouteFinder expects the peer (the client on the other side of the WAN link) to be configured with a User Name and Password combination that is in the DSU RouteFinder's User Database. The User Name and Password are both ASCII character strings that can be up to 30 characters long. However, for router-to-router connections, authentication is normally not used and the User Name and Password fields are empty.

The **Periodic Timer** option shows the interval between authentication checks. The recommended value is 60 seconds. The **Number of Retries** option, with a recommended value of 5, refers to the number of retries during each PAP or CHAP authentication check.

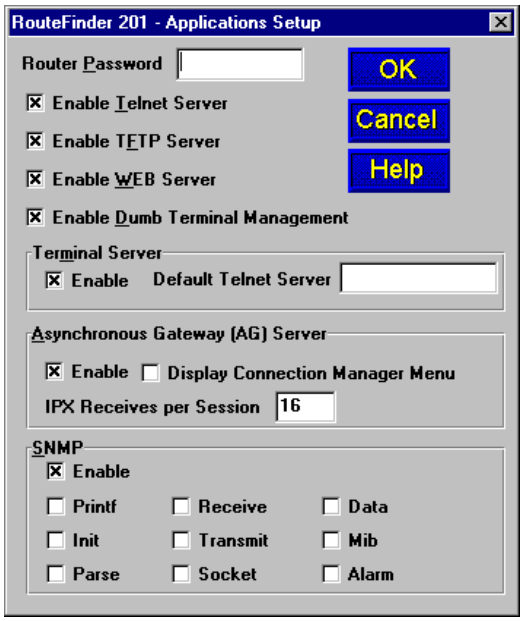
If SLIP is to be used on WAN 2 (the only WAN port that can be configured as a dial-out port), then select the SLIP Enable option on this tab and PPP will be disabled automatically. If the TCP/IP header is to be compressed using VJC compression, then check the **CSLIP (Van Jacobson Compression)** option. (Note: on answering WAN ports, the DSU RouteFinder can detect the type of connection -- PPP or SLIP.)

You can set up the DSU RouteFinder to bring down the connection on the WAN link when there is no real data traffic on the line; the router will then automatically bring up the WAN link when data is available to go across the link.

# Applications Setup

In addition to local configuration, the DSU RouteFinder supports various applications that enable it to be configured remotely from anywhere on the connected Internetwork. To manage these applications, click **Others** on the **Router Setup** screen.

The **Applications Setup** dialog box appears.




Enter a valid **Router Password** to make changes through the Applications Setup dialog box. Verify that the desired applications are enabled. By default, the DSU RouteFinder enables all six built-in server applications and SNMP. To disable any of these applications, click the corresponding check box.

In the **Terminal Server** group, enter the IP address of the Default Telnet host in the text box that is provided. After first checking the WAN port specific Telnet host address field on the Port Setup dialog box, the router will look in this field for the address of a Telnet host. If both fields are empty, the user will be asked to type in the address of the Telnet host. (If DNS resolver is enabled, and DNS Name server is available, the user can enter the domain name, instead of an IP address).

In the **Asynchronous Gateway (AG) Server** group, 16 is the recommended maximum number of IPX Receive commands allowed per session. The Display Connection Manager Menu option enables a user to select either a default Logon screen with a list of hosts awaiting connection (check box is enabled) or an optional screen that merely displays the words, CONNECTION MANAGER (check box is not enabled). In the former case, the user can see and select the number correlating to the desired host. At the optional screen, the user will be prompted for a user name and password and will have to then enter the appropriate information to access the host (if that host happens to be available).

The check boxes in the **SNMP** (Simple Network Management Protocol) group can be used to enable or disable SNMP management support and set up various conditions for messages. Normally, all the message items are left disabled to prevent degradation in router performance.

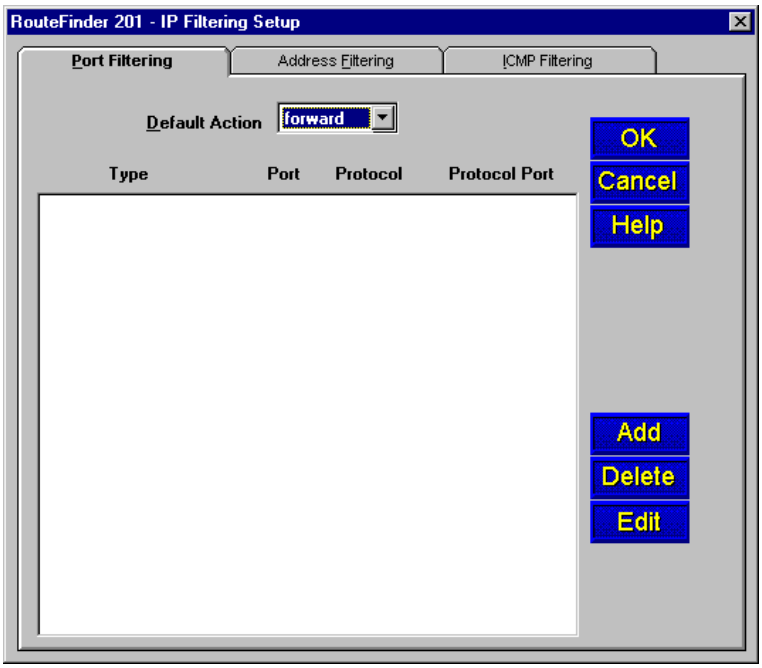
For more information on using these remote configuration applications, refer to Chapter 5 - Remote Configuration and Management.

# Filtering

The **IP Filtering Setup** dialog provides tabs that let you configure the RouteFinder so that IP packets that are received by the server can be selectively filtered or forwarded based on their addresses or by the protocol ports to which they are destined.

The three filtering methods are:

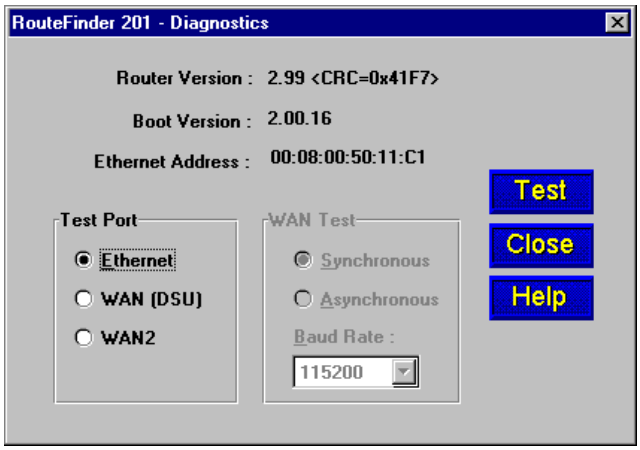
- **IP Protocol Port Based Filtering** - In this method, IP packets can be filtered based on their specific purposes; e.g., Telnet packets (TCP based) or TFTP (UDP based) can be filtered or forwarded.
- **IP Address Based Filtering** - In this method, filtering is based on the source and destination IP addresses in the packet.
- **ICMP Filtering** - Separate filtering support is provided for specific kinds of received ICMP packets.




For a more detailed description of filtering, refer to the on-line help provided with your RouteFinder software.

# Diagnostics

The DSU RouteFinder is equipped with a built-in diagnostics utility that can be accessed through the COM port of your PC (remote users cannot access diagnostics). Click **Built-in Test** in the **Router Setup** menu and the **Diagnostics** dialog is displayed.

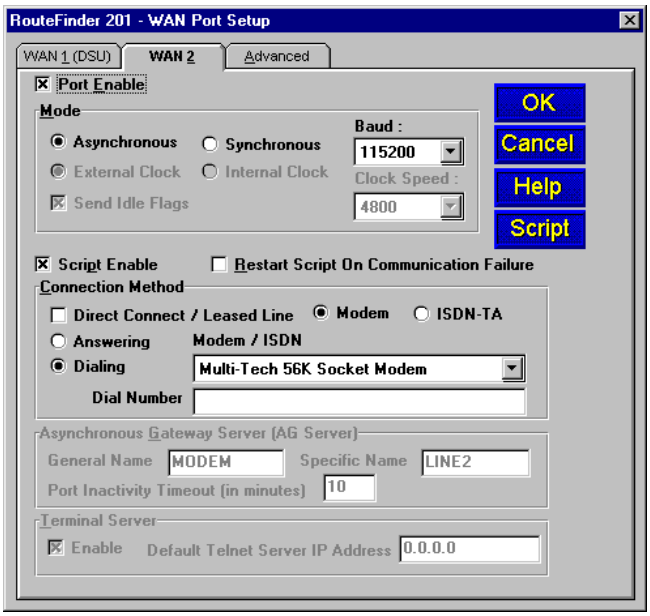



Select the port you wish to run diagnostics on from the **Test Port** group (Ethernet, WAN 1 or WAN 2), then click **Test** to start the test.

For more details and parameters about specific fields within the diagnostics dialog, refer to the on-line help provided with your RouteFinder software.

# Scripting

To enable scripting, click **WAN** from the **Router Setup** menu, and click the **WAN 2** tab (scripting cannot be enabled on the WAN 1 (DSU) port).




Click the **Script Enable** check box to enable scripting. Click **Script** to access scripting options. The **Script Dialog** menu is displayed. From this menu, you can edit, compile and download scripts.

For more information on scripting, refer to Appendix B - Scripting.

RouteFinder™

Multi-Protocol Router with 56K DSU

# Chapter 5 - Remote Configuration and Management

MultiTech® Systems

# Introduction

This chapter provides procedures for changing the configuration of a remote DSU RouteFinder. Remote configuration allows a PC at one site (local site) to dial a remote DSU RouteFinder and change the configuration of that remote unit. Remote configuration can be accomplished either directly through the LAN or remotely using modems. To remotely configure a DSU RouteFinder, a local PC needs to be connected to a dial-up line and the DSU RouteFinder software configured to call the remote DSU RouteFinder. The remote DSU RouteFinder needs to have a modem connected to a dial-up line and the Command Port. Once the connection to the remote unit is made, you can change the configuration as you see fit. Once the configuration is changed, you can download the new configuration to the remote DSU RouteFinder. Refer to the Modem-Based Remote Configuration Procedure in this chapter to remotely configure a DSU RouteFinder.

To configure the remote DSU RouteFinder through the LAN, change the communication type to the IP based Trivial File Transfer Protocol (known as TFTP) and change the configuration as you see fit. Refer to the LAN-Based Remote Configuration Procedure in this chapter to configure a remote DSU RouteFinder.

# Modem-Based Remote Configuration Procedure

1 At the remote site, remove the serial cable from the PC to the Command Port connector on the back panel of the DSU RouteFinder.

2 At the remote site, connect a special cable (Remote Configuration Cable) to the Command Port connector on the back panel of the DSU RouteFinder and the RS232 connector on the modem. The special cable is a serial cable with male connectors on both ends. Refer to Appendix A for cable details.

Connect the modem to your local telephone line.

Provide your telephone number to the person verifying your configuration.

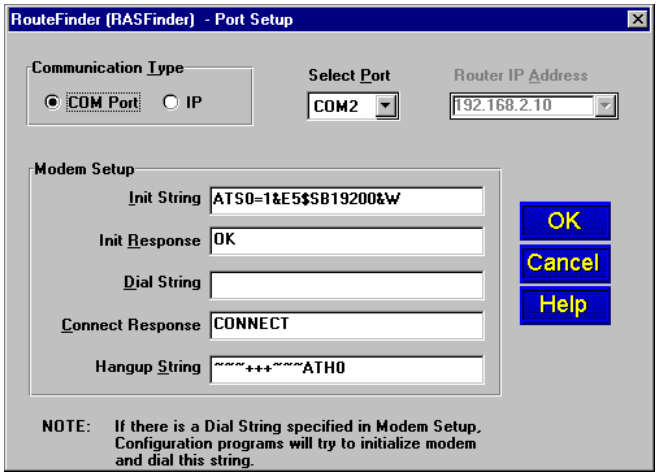
3 At the main site, connect your local PC to a modem that is connected to a dial-up line.

4 Install the DSU RouteFinder software on the local PC and start the **Configuration Port Setup** program:

*Windows 3.1x*: double-click the **Configuration Port Setup** icon in the DSU RouteFinder program group.

*Windows 95/98/NT*: Click **Start** | **Programs** | **RouteFinder** | **Configuration Port Setup**.

5 The **DSU RouteFinder Setup** dialog box is displayed.




Verify that the **Communication Type** is set to **COM Port** and the **Select Port** field is set to the COM port number (COM1 - COM4) of your local PC that is connected to the DSU RouteFinder.

In the **Dial String** field, enter the AT command for dialing (ATDT) plus the phone number of the remote DSU RouteFinder .

If your Modem Initialization String, Initialization Response, or Connect Response values are different from the defaults in the dialog box, refer to your modem user documentation and change the default values to match those required by your modem.

Click **OK** when you are satisfied with all your selections.

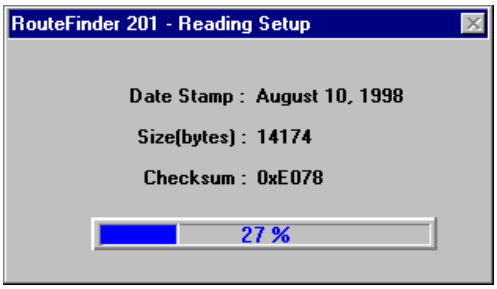
6 You are returned to the Windows program. Start the DSU RouteFinder Configuration program.

*Windows 3.1x*: Double-click the **Router Configuration** icon in the Program Manager.

*Windows 95/98/NT*: Click **Start** | **Programs** | **RouteFinder** | **Router Configuration**.

7 The **Dialing Router** dialog box is displayed while software is dialing the remote DSU RouteFinder.

8 The **Reading Setup** dialog box is displayed.




9 The **Router Setup** dialog box is displayed. This is the dialog box of the remote DSU RouteFinder. Refer to Chapter 4 for a description of each dialog box. For a detailed description of each field within a dialog box, refer to the on-line helps provided within your RouteFinder software.


10 After you have changed the configuration of the remote RouteFinder, click **Download Setup** to update the configuration. The remote RouteFinder will be brought down, the new configuration written to the unit, and the unit will reboot.

11 Click **Exit** when the download is complete.

12 The **Hangup connection with Router?** dialog box is displayed.

Click **Yes** to disconnect the phone connection to the remote site.

13 If the same telephone number is **not** going to be used again in the immediate future, you may want to remove it from the Port Setup dialog box.

14 At the remote site, reconnect the DSU RouteFinder to the serial port of the PC and from the Program Manager screen click the **Router Configuration** icon to verify that the RouteFinder is running.

# LAN-Based Remote Configuration Procedure

## Windows Sockets Compliant TCP/IP Stack

The configuration program requires a Windows Sockets compliant TCP/IP stack. Microsoft provides a TCP/IP stack free for Windows for Workgroups 3.11. TCP/IP protocol software must be installed and functional before the configuration program can be used.

1 You must assign an Internet (IP) address for the PC and for each node that will be managed by the configuration program. Refer to the protocol software documentation for instructions on how to set the IP addresses.

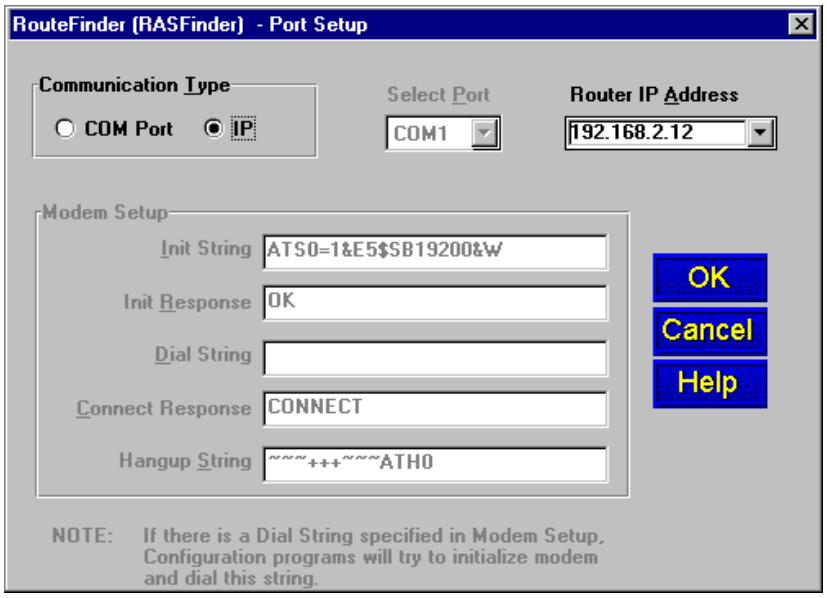
Once you have completed this step, you should be able to use the protocol Ping command for the PC host name. You should also test the network interface configuration by Pinging another TCP/IP device that is connected to the network.

2 Install the DSU RouteFinder software on the local PC and at the Windows Program Manager screen, run the **Configuration Port Setup** program:

*Windows 3.1x*: double-click the **Configuration Port Setup** Icon in the DSU RouteFinder program group.

Windows 95/98/NT: Click **Start** | **Programs** | **RouteFinder** | **Configuration port setup**.

3 The port setup dialog box is displayed.




Verify that the **Communication Type** is set to **IP.**

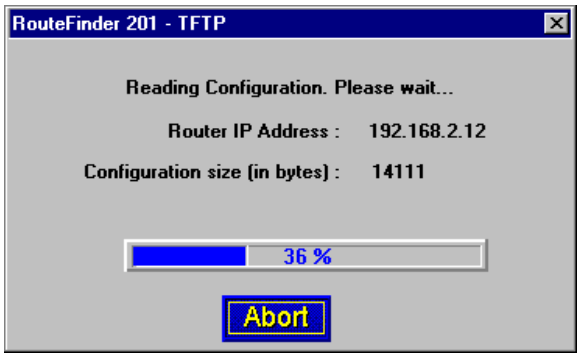
In the **IP Address** field, enter the IP Address of the remote DSU RouteFinder.

4 Click **OK** when you are satisfied with your selections.

The Windows Program Manager menu is displayed.

5 Double-click the **Router Configuration** icon.

The following dialog box is displayed:




6 The Router Setup dialog box is then displayed. This is the dialog box for the remote DSU RouteFinder. You can select any of the available buttons and change the configuration (or setup) and download the changes to the remote DSU RouteFinder. Refer to Chapter 4 for a description of the DSU RouteFinder software. For definitions of each dialog box or fields within a dialog box, refer to the on-line helps provided in the software.


7 After you have changed the configuration of the remote DSU RouteFinder, click **Download Setup** to update the configuration. The remote DSU RouteFinder will be brought down, the new configuration written to the unit, and the unit will reboot.

8 Click **Exit** when the download is complete.

9 Click the **Router Configuration** icon in the Program Manager screen to verify that the RouteFinder is running.

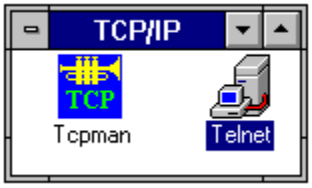
# Remote Management

This section describes typical client applications that can be used to configure the RouteFinder remotely. It is important to note that although any subsequent changes to configuration can be made using these applications, the initial setup and configuration of the RouteFinder must be done on the local PC, using the RouteFinder software provided with your unit.

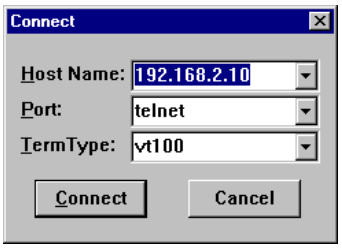
Although establishing access to the RouteFinder varies between applications, the configuration functions mirror those of the RouteFinder software. For more information on RouteFinder software, refer to Chapter 4 - DSU RouteFinder Software.

## Telnet

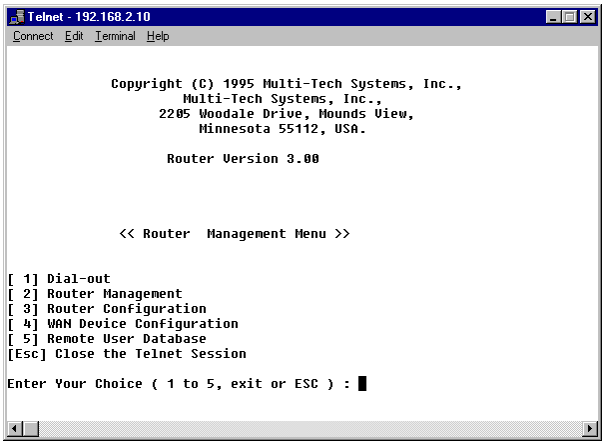
A typical Telnet client application is described in this section. The DSU RouteFinder has a built-in Telnet Server that enables Telnet client PCs to access the RouteFinder. A typical Telnet client is allowed to configure the RouteFinder and WAN devices. A typical TCP/IP program group is shown below with a Tcpman icon and a Telnet icon.




The TCP/IP stack has to be loaded before the Telnet client, a Windows application, can run. Double-Click the Telnet icon and a blank Telnet screen is displayed. Click the **Connect** menu; if the desired IP Address is listed in the drop-down menu, select it. Otherwise, select **Remote System** and when the **Connect** dialog box opens, enter the desired IP Address in the **Host Name** field and Click **Connect**.




When you enter a valid Host Name (IP Address) and click Connect, you are immediately connected to the target RouteFinder and the Router Management Menu screen is displayed.



## Router Management

The Router Management Menu provides four functional options in addition to the option of escaping and closing the Telnet session.

### Dial-Out

The Dial-out option (Option 1) on the Router Management Menu enables a Telnet user to configure WAN 2 for a dial-out session. The default configuration of 115200 bps, 8N1 can be used for the dial-out session, or the user can specify each parameter for the port (e.g., the baud rate, the number of data bits, parity, or the number of stop bits). When the connection is established, anything entered on the keyboard is immediately presented to WAN 2. When the dial-out session is over, WAN 2 reverts to its original configuration.

### Router Configuration

The Router Configuration option (Option 2) on the Router Management Menu enables a Telnet user to view and change parameters on the protocol stacks, high or low level device drivers, enable or disable the supported servers, or view system information.

### WAN Device Configuration

The WAN Device Configuration option (Option 3 on the Router Management Menu) allows a remote user to gain access to any available WAN port on the DSU RouteFinder. The user can select either Port 1 or Port 2.

### Remote User Database

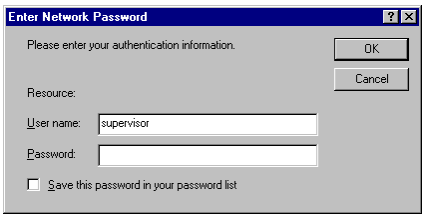
The Remote User Database option (Option 4 on the Router Management Menu) allows a remote user to add user information such as Name and Password, callback information, and which protocol stacks to enable or disable.

## Web Browser Management

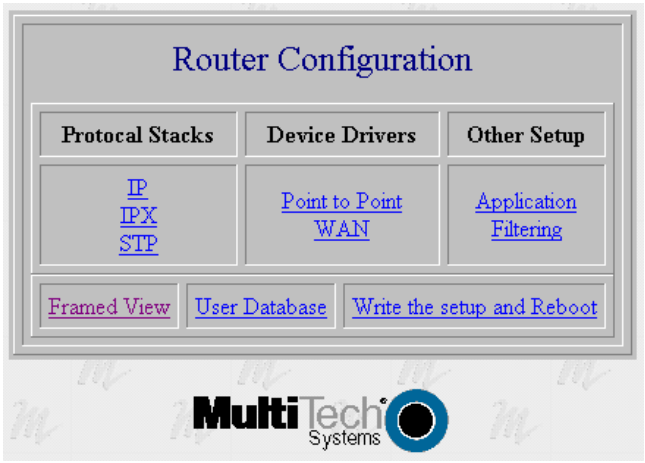
The DSU RouteFinder can be accessed from anywhere on the connected Internet via its built-in Web Browser interface. For this function to be enabled, the **Enable WEB Server** check box on the Applications Setup dialog box must be checked. Depending on the rights of the user (read/write, or read only), it is possible to view the current parameters and statistics of the DSU RouteFinder as well as configure and download setup changes to the unit.

You can access the Router Configuration screen by typing the **IP Address** of the unit into the address line of your web browser. The RouteFinder Login page is displayed.


When the Welcome screen appears, click the word **Login** to gain access to the DSU RouteFinder. The **Enter Network Password** screen appears.




Enter your **User name** and **Password**, then click **OK** to go to the Router Configuration menu.




**Note:** The first user to access the DSU RouteFinder will have *read/write* rights over the unit. All subsequent users will have *read only* rights, and therefore, some of the options within the Web interface will be inactive (i.e., will not be linked).

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# Chapter 6 - Warranty, Service and Tech Support

MultiTech® Systems

# Introduction

This chapter starts out with statements about your DSU RouteFinder 2-year warranty. The next section, Tech Support, should be read carefully if you have questions or problems with your DSU RouteFinder. It includes the technical support telephone numbers, space for recording your product information, and an explanation of how to send in your DSU RouteFinder should you require service. The next few sections explain how to use our bulletin board service (BBS), and get support through the Internet.

# Limited Warranty

Multi-Tech Systems, Inc. (“MTS”) warrants that its products will be free from defects in material or workmanship for a period of two years from the date of purchase, or if proof of purchase is not provided, two years from date of shipment. MTS MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by the customer or any party without MTS’s written authorization, or used in any manner inconsistent with MTS’s instructions.

MTS’s entire obligation under this warranty shall be limited (at MTS’s option) to repair or replacement of any products which prove to be defective within the warranty period, or, at MTS’s option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS’s factory transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PURCHASE PRICE FOR DEFECTIVE PRODUCTS.

## On-line Warranty Registration

If you would like to register your DSU RouteFinder electronically, you can do so at the following address:

**http://www.multitech.com/register**

# Service

If your tech support specialist decides that service is required, your DSU RouteFinder may be sent (freight prepaid) to our factory. Return shipping charges will be paid by Multi-Tech Systems.

Include the following with your DSU RouteFinder:

- a description of the problem.
- return billing and return shipping addresses.
- contact name and phone number.
- check or purchase order number for payment if the DSU RouteFinder is out of warranty. (Check with your technical support specialist for the standard repair charge for your DSU RouteFinder).
- if possible, note the name of the technical support specialist with whom you spoke.

If you need to inquire about the status of the returned product, be prepared to provide the **serial number** of the product sent.

Send your DSU RouteFinder to this address:

MULTI-TECH SYSTEMS, INC.

2205 WOODALE DRIVE

MOUNDS VIEW, MINNESOTA 55112

ATTN: SERVICE OR REPAIRS

You should also check with the supplier of your DSU RouteFinder on the availability of loaner units and/or local service in your area.

# Tech Support

Multi-Tech has an excellent staff of technical support personnel available to help you get the most out of your Multi-Tech product. If you have any questions about the operation of this unit, call 1-800-972-2439. Please fill out the DSU RouteFinder information (below), and have it available when you call. If your DSU RouteFinder requires service, the tech support specialist will guide you on how to send in your DSU RouteFinder (refer to the next section).

## Recording DSU RouteFinder Information

Please fill in the following information on your Multi-Tech DSU RouteFinder. This will help tech support in answering your questions. (The same information is requested on the Warranty Registration Card.)

Model No.: _____
Serial No.: _____
Software Version: _____

The model and serial numbers are on the bottom of your DSU RouteFinder.

Please note the type of external link device that is connected to your DSU RouteFinder before calling tech support. Also, note the status of your DSU RouteFinder including LED indicators, screen messages, diagnostic test results, DIP-Switch settings, problems with a specific application, etc. Use the space below to note the DSU RouteFinder status:

_____

_____

_____

_____

_____

_____

_____

_____

# The Multi-Tech BBS

For customers who do not have Internet access, Multi-Tech maintains a bulletin board system (BBS) that mirrors its FTP site. Information available from the BBS includes new product information, product upgrade files, and problem-solving tips. The phone number for the Multi-Tech BBS is (800) 392-2432 (USA and Canada) or (612) 785-3702 (international and local).

The BBS can be accessed by any asynchronous modem operating at 1200 bps to 33,600 bps at a setting of 8 bits, no parity, and 1 stop bit (8-N-1).

## To log on to the Multi-Tech BBS

1. Set your communications program to **8-N-1**.
2. Dial our BBS at (800) 392-2432 (USA and Canada) or (612) 785-3702 (international and local).
3. At the prompts, type your first name, last name, and password; then press ENTER. If you are a first time caller, the BBS asks if your name is spelled correctly. If you answer yes, a questionnaire appears. You must complete the questionnaire to use the BBS on your first call.
4. Press ENTER until the Main Menu appears. From the Main Menu you have access to two areas: the Files Menu and News. For help on menu commands, type **?**.

## To Download a file

### If you know the file name

1. From the Main Menu, type **F** to access the Files Menu, then type **D**.
2. Enter the name of the file you wish to download from the BBS.
3. If a password is required, enter the password.
4. Answer **Y** or **N** to the automatic logoff question.
5. Select a file transfer protocol by typing the indicated letter, such as **Z** for Zmodem (the recommended protocol).
6. If you select Zmodem, the transfer will begin automatically. If you select another protocol, you may have to initiate the transfer yourself. (In most datacomm programs, the PAGE DOWN key initiates the download.)
7. When the download is complete, press ENTER to return to the File Menu.
8. To exit the BBS, type **G** and press ENTER.

### If you don’t know the file name

1. From the Main Menu, type **F** to access the Files Menu. For a list of file areas, type **L**, press ENTER, then type **L** and press ENTER again. (If you do not type the second *L*, you will list all of the files on the BBS.)
2. Mark each file area you would like to examine by typing its list number and pressing ENTER.
3. Enter **L** to list all the files in the selected file areas. Enter **C** to go forward in the file list and **P** to go back.
4. To mark one or more files for download, type **M**, press ENTER, type the list numbers of the files, and press ENTER again.

5. Enter **D**. You will see a list of the files you have marked. Enter **E** if you would like to edit the list; otherwise enter **D** again to start the download process.
6. Select a file transfer protocol by typing the indicated letter, such as **Z** for Zmodem (the recommended protocol).
7. If you select Zmodem, the file will transfer automatically. If you select another protocol, you may have to initiate the transfer yourself. (In most data communications programs, the PAGE DOWN key initiates the download.)
8. When the download is complete, press ENTER to return to the File Menu.
9. To exit the BBS, type **G** and press ENTER.

# About the Internet

If you prefer to receive technical support via the Internet, you can contact Tech Support via e-mail at the following address:

**http://www.multitech.com/support**

Multi-Tech's presence includes a Web site at:

**http://www.multitech.com**

and an ftp site at:

**ftp://ftp.multitech.com**

RouteFinder™

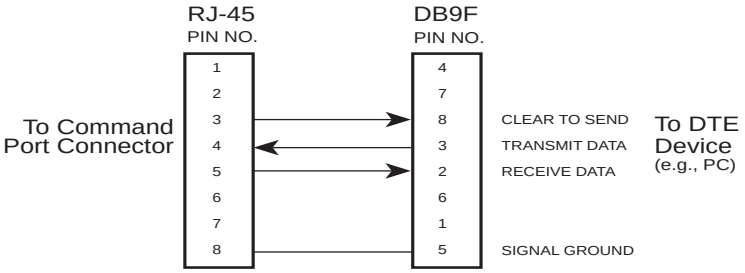
Multi-Protocol Router with 56K DSU

# Appendixes

MultiTech® Systems

# Appendix A - Cabling Diagrams

## Command Port Cable

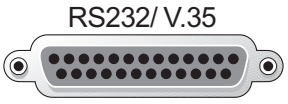



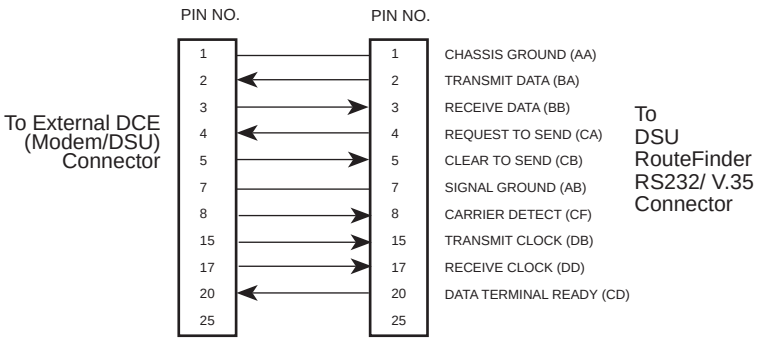

Note: RJ-45 pins 3,4,5, and 8 are the only ones used.

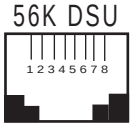
## LAN Cable


| Pin | Circuit | Signal Name |
|---|---|---|
| 1 | TD+ | Data Transmit Positive |
| 2 | TD- | Data Transmit Negative |
| 3 | RD+ | Data Receive Positive |
| 6 | RD- | Data Receive Negative |

## WAN Cables




| Pins | Circuit |
|---|---|
| 1,2 | Transmit |
| 7,8 | Receive |

# Appendix B - Scripting

The script file can be used to automate certain operation. The script file is a text file containing a sequence of commands. The structure of a script file is succinctly expressed by the following grammar.

## Script Language Grammar

<program> =<declarations> <proc_declarations>
<declarations> ={<var_type> <identifier> {, <identifier> } ; }
<var_type> =INTEGER I STRING
<statement_list> ={<statement>}
<statement> =<elementary_statement> I <if_statement> I<for_statement> I
<while_statement> I <switch_statement>
<if_statement> =IF <expression> THEN <statement_list> {ELSE<statement_list> }
ENDIF
<for_statement> =FOR <identifier>=<expression> TO IDOWNTO <expression} STEP
<expression> / DO <statement_list> ENDFOR
<while_statement> =WHILE <expression> DO <statement_list> ENDWHILE
<switch_statement>=SWITCH <expression> {CASE <integer_const> <statement_list> I
CASE <string_const> <statement_list> I
DEFAULT <statement_list> }
ENDSWITCH
<elementary_statement> =<identifier> = <expression> ; I <identifier> / (<expression>
{,<expression> } ) /; I GOTO <identifier> ; I <identifier> : I ;
<expression> =<expression> OPERATOR <expression> I {<expression> } I /
<expression>I
- <expression> I<identifier> / (<expression> {, <expression> } ) /
OPERATOR = **<** I **<=** I > I >= I == I **!=** I **&&** I II I **+** I - I * I / I **!**
<proc_declaration> =PROC <identifier>/(<parameter_list>)} { :<vartype> };FORWARD ;
<proc_declaration> =PROC <identifier>/(<parameter_list>)} / : <vartype> / ;
<declarations> <statement_list>ENDPROC
<parameter_list> =<argument_list> { ; <argument_list>}
<argument_list> ={VAR} <var_type> <identifier> {<identifier>}

Execution starts at the PROC main. PROC main cannot have any arguments. All the variables have to be declared before use. All procedures must be declared before calling. Recursion is allowed in procedures.

To define mutually recursive procedures, use the FORWARD directive to indicate that the procedure body is defined later in the source file. Procedures defined with the FORWARD directive should have all the parameters and return value (if any) specified, the actual definition of the procedure body should not contain the formal parameter list or the return value. An example of forward defined procedures is given below:

```
proc a(integer x,y) : integer,forward:
proc b(integer u,v) : integer,forward:
proc a;
    integer t;
    /*Some more code here. */

    t=b(x,y);
    /*Some more code here. */
    return(t);
endproc

proc b;
    return(a(u,v);
endproc
```

Argument to procedures can be passed by value or address. To pass an argument by address, prefix the argument name in the formal parameter list by the keyword VAR; otherwise the argument is passed by value. Only variables can be passed by address. Expressions like A+B, where A and B are integer variables can be passed by value but cannot be passed by address.

## Two basic types of variables are supported:

INTEGER and STRING

In the STRING, since the ASCII null character is internally used to indicate the end of the sequence, it cannot be part of the string. All other characters, including extended ASCII characters can be part of the string.

## There are two types of conditional constructs: IF and SWITCH

The IF statement is a two-way branching construct. The condition can be an arbitrary expression. The condition in the IF statement should evaluate to an integer or real. If the expression in the IF statement evaluates to non-zero, the control enters the THEN statement, otherwise control enters the ELSE statement.

The SWITCH statement is a multi-way branching construct. The type of conditional expression should be either INTEGER or STRING. The value of the conditional expression is matched against the constraints given in the CASE options, if the value matches a CASE option value, control enters that CASE option. If the values do not match any of the CASE options, and if a DEFAULT option is provided, control continues at the DEFAULT option; otherwise control continues at the statement after the ENDSWITCH. If control enters one of the CASE or DEFAULT statements, all the statements up to the next ENDCASE statement are executed. Each CASE or DEFAULT statement should be terminated by a matching ENDCASE keyword. The SWITCH statement should be terminated by a ENDSWITCH keyword. The DEFAULT statement can be placed anywhere within the scope of the SWITCH statement. There can be only one DEFAULT statement.

## There are two types of iterative constructs: FOR and WHILE

The FOR construct sets the loop control variable to an initial value. The control variable is checked for bounds, and if within bounds, the <statement_list> given is executed; otherwise the loop execution terminates. After each execution of <statement_list>, the control variable is incremented or decremented by a certain value. This is computed as follows: if the STEP expression is given it is the value of the expression, else it is 1. The control variable is incremented if TO is specified, and is decremented if DOWNTO is specified. After updating the control variable the bounds check is done again. The keyword ENDFOR is mandatory at the end of the loop.

The WHILE loop has an expression and a <statement_list>. The expression is evaluated and if the expression is non-zero the <statement_list> is executed; otherwise the loop execution terminates. The keyword ENDWHILE is mandatory at the end of the loop.

**Operator Precedence:**

Operators are listed in the order of precedence

Unary Operators :-!(unary minus, logical negation)
Binary Operators :*/ **+ _< > <= >= == ! = &&** II

All the operators are left associative. Expressions are evaluated completely; so care must be taken while writing expressions. For example, expressions like (a !=0 && b / a) would create run time error.

# Script Commands (by Function)

## Dial, Connection and Remote

| | | |
|---|---|---|
| BAUDRATE | BREAK | GETCTS |
| GETDCD | HANGUP | PARITY |
| RGETC | RGETS | RXFLUSH |
| SETDTR | SETRTS | STOPBITS |
| THISLAYERUP | TRANSMIT | TXFLUSH |
| WAITFOR | | |

## Mathematical functions

| | |
|---|---|
| DEC | INC |

## Miscellaneous

| | |
|---|---|
| EXIT | WAIT |

## Program constructs

| | | |
|---|---|---|
| FOR | IF | PROC |
| SWITCH | WHILE | |

## String operations

| | | |
|---|---|---|
| ATOI | ITOA | STRCAT |
| STRCMP | STRCOPY | STRFMT |
| STRLEN | TOLOWER | TOUPPER |

## Example Script:

```
proc main;
    string login_prompt;
    string user_name;
    string password_prompt;
    string password;
    string shell_menu;
    string shell_menu_response;
    integer timeout;

    timeout=10;
    login_prompt=”login:”;
    user_name=”user1”;
    password_prompt=”Password:”;
    password=”user1”;
    shell_menu=”choice:”;
    shell_menu_response=”1”;

    transmit(“A”);
    wait(1)
    transmit(“T^M”);
    waitfor (“OK”,10);
```

```
        transmit (“A”);
        wait (1);
        transmit (“T”);
        wait (1);
        transmit (“DT963^M”);

        if (waitfor (login_prompt,60)) then
                transmit (user_name);
                transmit (“^M”);
                if (waitfor (password_prompt,timeout)) then
                        transmit (password);
                        transmit (“^M”);
                        if (waitfor (shell_menu,timeout)) then
                        transmit (shell_menu_response);
                        transmit (“^M”);
        else
                        transmit (“Shell Menu Not Received^M”);
        endif
else
        transmit (“Password Prompt Not Received^M”);
        endif
else
        transmit (“Login Prompt Not Received^M”);
endif

Endproc
```

# Appendix C - Regulatory Information

## Class A Statement

### FCC Part 15

**NOTE:** This equipment has been tested and found to comply with the limits for a **Class A** digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This device complies with Part 15 of the FCC rules.
Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference that may cause undesired operation.

**Warning:** Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### Industry Canada

This **Class A** digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numerique de la classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

CE

# EMC and Safety Directive Compliance

The CE mark is affixed to this Multi-Tech product to confirm compliance with the following European Community Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility.

and

Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits:

each amended by

Council Directive 93/68/EEC of 22 July 1993 on the harmonization of CE marking requirements.

## FCC Part 68 Telecom

1. This equipment complies with Part 68 of the Federal Communications Commission (FCC) rules. On the outside surface of this equipment is a label that contains, among other information, the FCC registration number. This information must be provided to the telephone company.

2. As indicated below, the suitable jack (Universal Service Order Code connecting arrangement) for this equipment is shown. If applicable, the facility interface codes (FIC) and service order codes (SOC) are shown.

3. An FCC-compliant telephone cord with modular plug is provided with this equipment. This equipment is designed to be connected to the phone network or premises wiring using a compatible modular jack which is Part 68 compliant. See installation instructions for details.

4. If this equipment causes harm to the phone network, the phone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the phone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

5. The phone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the phone company will provide advance notice in order for you to make necessary modifications in order to maintain uninterrupted service.

6. If trouble is experienced with this equipment (the model of which is indicated below) please contact Multi-Tech Systems, Inc., at the address shown below for details of how to have repairs made. If the equipment is causing harm to the network, the phone company may request that you remove the equipment from the network until the problem is resolved.

7. No repairs are to be made by you. Repairs are to be made only by Multi-Tech Systems or its licensees. Unauthorized repairs void registration and warranty.

8.

| | |
|---|---|
| Manufacturer: | Multi-Tech Systems, Inc. |
| Trade name: | RouteFinder |
| Model Numbers: | MTASR2-201 |
| FCC Registration Number: | AU7USA-250603-XD-N |
| Modular Jack: | RJ-45 |
| Service Center in U.S.A.: | Multi-Tech Systems Inc.<br>2205 Woodale Drive<br>Mounds View, MN 55112<br>(612) 785-3500 Fax (612) 785-9874 |

# Canadian Limitations Notice

## Ringer Equivalence Number

**Notice**: The ringer equivalence number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a phone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

**Notice:** The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations. Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, phone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

**Caution:** Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

RouteFinder™

Multi-Protocol Router with 56K DSU

# Glossary of Terms

MultiTech® Systems

## A

**Access:** The T1 line element made up of two pairs of wire that the telephone company brings to the customer premises. The Access portion ends with a connection at the local Telco (LEC or RBOC).

**Accunet Spectrum of Digital Services (ASDS):** The AT&T 56 Kbps leased (private) line service. Similar to services of MCI and Sprint. ASDS is available in nx56/64 Kbps, where n=1, 2, 4, 6, 8, 12.

**ACK (ACKnowledgement code) (pronounced "ack"):** A communications code sent from a receiving modem to a transmitting modem to indicate that it is ready to accept data. It is also used to acknowledge the error-free receipt of transmitted data. Contrast with NAK.

**Adaptive Differential Pulse Code Modulation (ADPCM):** In multimedia applications, a technique in which pulse code modulation samples are compressed before they are stored on a disk. ADPCM, an extension of the PCM format, is a standard encoding format for storing audio information in a digital format. It reduced storage requirements by storing differences between successive digital samples rather than full values.

**Address:** A numbered location inside a computer. It's how the computer accesses its resources, like a video card, serial ports, memory, etc.

**AMI line coding:** One of two common methods of T1 line coding (with B8ZS). AMI line coding places restrictions on user data (B8ZS does not).

**Analog signal:** A waveform which has amplitude, frequency and phase, and which takes on a range of values between its maximum and minimum points.

**Analog Transmission:** One of two types of telecommunications which uses an analog signal as a carrier of voice, data, video, etc. An analog signal becomes a carrier when it is modulated by altering its phase, amplitude and frequency to correspond with the source signal. Compare with digital transmission.

**Application Program Interface (API):** A software module created to allow dissimilar, or incompatible applications programs to transfer information over a communications link. APIs may be simple or complex; they are commonly required to link PC applications with mainframe programs.

**ASCII (American Standard Code for Information Interchange) (pronounced "askey"):** A binary code for data that is used in communications and in many computers and terminals. The code is used to represent numbers, letters, punctuation and control characters. The basic ASCII code is a 7-bit character set which defines 128 possible characters. The extended ASCII file provides 255 characters.

**Asynchronous Transfer Mode (ATM):** A very high-speed method of transmission that uses fixed-size cells of 53 bytes to transfer information over fiber; also known as cell relay.

**AT Commands:** A standard set of commands used to configure various modem parameters, establish connections and disconnect. The "AT" is used to get the "attention" of the modem before the actual command is issued.

**Availability:** The measure of the time during which a circuit is ready for use; the complement of circuit "outage" (100% minus % outage = % available).

## B

**B7ZS (Bipolar 7 Zero Suppression) line coding:** One method of T1 line coding (see also "B8ZS" and "AMI"). B7ZS line coding does not place restrictions on user data (AMI does).

**B8ZS (Bipolar 8 Zero Suppression) line coding:** One of two common methods of T1 line coding (with AMI). B8ZS line coding does not place restrictions on user data (AMI does). A coding method used to produce 64 Kbps "clear" transmission. (See also "B7ZS" and "AMI" line coding)

**Backbone:** 1. A set of nodes and their interconnecting links providing the primary data path across a network. 2. In a local area network multiple-bridge ring configuration, a high-speed link to which the rings are connected by means of bridges. A backbone may be configured as a bus or as a ring. 3. In a wide area network, a high-speed link to which nodes or data switching exchanges (DSEs) are connected. 4. A common distribution core that provides all electrical power, gases, chemicals, and other services to the sectors of an automated wafer processing system.

**Background:** An activity that takes place in the PC while you are running another application. In other words, the active user interface does not correspond to the 'background' task.

**Bandwidth:** The transmission capacity of a computer channel, communications line or bus. It is expressed in cycles per second (hertz), the bandwidth being the difference between the lowest and highest frequencies transmitted. The range of usable frequencies that a transmission medium will pass without unacceptable attenuation or distortion. Bandwidth is a factor in determining the amount of information and the speed at which a medium can transmit data or other information.

**Backward Explicit Congestion Notification (BECN):** A bit that tells you that a certain frame on a particular logical connection has encountered heavy traffic. The bit provides notification that congestion-avoidance procedures should

be initiated in the opposite direction of the received frame. See also FECN (Forward Explicit Congestion Notification).

**Basic Rate Interface (BRI):** An ISDN access interface type comprised of two B-channels each at 64 Kbps and one D-channel at 64 Kbps (2B+D).

**Bell Operating Companies (BOC):** The family of corporations created during the divestiture of AT&T. BOCs are independent companies which service a specific region of the US. Also called Regional Bell Operating Companies (RBOCs).

**Bell Pub 41450:** The Bell publication defining requirements for data format conversion, line conditioning, and termination for direct DDS connection.

**Bell Pub 62310:** The Bell publication defining requirements for data format conversion, line conditioning, and termination for direct DDS connection.

**Binary Synchronous Communication (BSC):** A form of telecommunication line control that uses a standard set of transmission control characters and control character sequences, for binary synchronous transmission of binary-coded data between stations.

**Bit (Binary digIT):** A bit is the basis of the binary number system. It can take the value of 1 or 0. Bits are generally recognized as the electrical charge generated or stored by a computer that represent some portion of usable information.

**Bit Error Rate Test (BERT):** A device or routine that measures the quality of data transmission. A known bit pattern is transmitted, and the errors received are counted and a BER (bit error rate) is calculated. The BER is the ratio of received bits in error relative to the total number of bits received, expressed in a power of 10.

**Bit robbing:** The use of the least significant bit per channel in every sixth frame for signaling. The line signal bits “robbed” from the speech part conveys sufficient pre-ISDN telephony signaling information with the remaining line signal bits providing sufficient line signaling bits for recreating the original sound. See “robbed bit signaling”.

**Blue Alarm:** An error indication signal consisting of all 1s indicating disconnection or attached device failure. Contrast “Red Alarm” and “Yellow Alarm”.

**Bps (bits per second):** A unit to measure the speed at which data bits can be transmitted or received. Bps differs from baud when more than one bit is represented by a single cycle of the carrier.

**Bridges:** 1. A functional unit that interconnects two local area networks that use the same logical link protocol but may use different medium access control protocols. 2. A functional unit that interconnects multiple LANs (locally or remotely) that use the same logical link control protocol but that can use different medium access control protocols. A bridge forwards a frame to another bridge based on the medium access control (MAC) address. 3. In the connection of local loops, channels, or rings, the equipment and techniques used to match circuits and to facilitate accurate data transmission.

**Buffer:** A temporary storage register or Random Access Memory (RAM) used in all aspects of data communications which prevents data from being lost due to differences in transmission speed. Keyboards, serial ports, muxes and printers are a few examples of the devices that contain buffers.

**Bus:** A common channel between hardware devices either internally between components in a computer, or externally between stations in a communications network.

**Byte:** The unit of information a computer can handle at one time. The most common understanding is that a byte consists of 8 binary digits (bits), because that’s what computers can handle. A byte holds the equivalent of a single character (such as the letter A).

## C

**Call Setup Time:** The time to establish a circuit-switched call between two points. Includes dialing, wait time, and CO/long distance service movement time.

**Carrier Group Alarm (CGA):** A T1 service alarm generated by a channel bank when an OOF condition occurs for a predefined length of time (usually 300 mS to 2.5 seconds). The CGA causes the calls using a trunk to be dropped and for trunk conditioning to be applied.

**Carrier signal:** An analog signal with known frequency, amplitude and phase characteristics used as a transport facility for useful information. By knowing the original characteristics, a receiver can interpret any changes as modulations, and thereby recover the information.

**CCITT (Consultative Committee for International Telephone and Telegraph):** An advisory committee created and controlled by the United Nations and headquartered in Geneva whose purpose is to develop and to publish recommendations for worldwide standardization of telecommunications devices. CCITT has developed modem standards that are adapted primarily by PTT (post, telephone and telegraph) organizations that operate telephone networks of countries outside of the U.S. See also ITU.

**Central Office (CO):** The lowest, or most basic level of switching in the PSTN (public switched telephone network). A business PABX or any residential telephone connects to the PSTN at a central office.

**Centrex:** A multi-line service offered by operating Telcos which provides, from the Telco CO, functions and features comparable to those of a PBX for large business users. See also “Private Branch Exchange”, “Exchange”.

**Channel:** A data communications path between two computer devices. Can refer to a physical medium (e.g., UTP or coax), or to a specific carrier frequency.

**Channel Bank:** A device that acts as a converter, taking the digital signal from the T1 line into a phone system and converting it to the analog signals used by the phone system. A channel bank acts as a multiplexer, placing many slow-speed voice or data transactions on a single high-speed link.

**Circuit-switched Network:** A technology used by the PSTN that allocates a pair of conductors for the exclusive use of one communication path. Circuit switching allows multiple conversations on one talk path only if the end-users multiplex the signals prior to transmission.

**Circuit Switching:** The temporary connection of two or more communications channels using a fixed, non-shareable path through the network. Users have full use of the circuit until the connection is terminated.

**Clear Channel**: A transmission path where the full bandwidth is used (i.e., no bandwidth needed for signaling, carrier framing or control bits). A 64 Kbps digital circuit usually has 8 Kbps used for signaling. ISDN has two 64 Kbps circuits, and a 16 Kbps packet service of which part is used for signaling on the 64K channels.

**Client-Server:** In TCP/IP, the model of interaction in distributed data processing in which a program at one site sends a request to a program at another site and awaits a response. The requesting program is called a client; the answering program is called a server.

**Cluster Controller:** A device that can control the input/output operations of more than one device connected to it. A cluster controller may be controlled by a program stored and executed in the unit, or it may be entirely controlled by hardware.

**Committed Burst Size:** The maximum number of bits that the frame relay network agrees to transfer during any measurement interval.

**Committed Information Rate (CIR):** An agreement a customer makes to use a certain minimum data transmission rate (in bps). The CIR is part of the frame relay service monthly billing, along with actual usage, that users pay to their frame relay service provider.

**Compression:** 1. The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks. 2. In SNA, the replacement of a string of up to 64-repeated characters by an encoded control byte to reduce the length of the data stream to the LU-LU session partner. The encoded control byte is followed by the character that was repeated (unless that character is the prime compression character). 3. In Data Facility Hierarchical Storage Manager, the process of moving data instead of allocated space during migration and recall in order to release unused space. 4. Contrast with decompression.

**COMx Port:** A serial communications port on a PC.

**Congestion:** A network condition where there is too much data traffic. The ITU I.233 standard defines congestion management in terms of speed and burstiness.

**Congestion notification:** The function in frame relay that ensures that user data transmitted at a rate higher than the CIR are allowed to slow down to the rate of the available network bandwidth.

**Consecutive Severely Errored Seconds (CSES):** An error condition that occurs when from 3 to 9 SES (Severely Errored Seconds) are logged consecutively.

**Customer Premise Equipment (CPE):** The generic term for data communications and/or terminal equipment that resides at the user site and is owned by the user with the following exclusions: Over voltage protection equipment, inside wiring, coin operated or pay telephones, “company-official” equipment, mobile telephone equipment, “911” equipment, equipment necessary for the provision of communications for national defense, or multiplexing equipment used to deliver multiple channels to the customer.

## D

**D4:** the T1 4th generation channel bank.

**D4 channelization:** Refers to the compliance with AT&T TR 62411 for DS1 frame layout.

**D4 framing:** The T1 format for framing in AT&T D-Series channel banks, in which there are 12 separate 193-bit frames in a super-frame. A D4 framing bit is used to identify the channel and the signaling frame. Signalling for voice channels is carried in-band for every channel, along with the encoded voice. See “robbed-bit signaling”.

**Data Communications Equipment (DCE):** Any device which serves as the portal of entry from the user equipment to

a telecommunications facility. A modem is a DCE for the telephone network (PSTN) that is commonly on site at the user's premises. Packet Switched Networks have another level of DCE which is most often located at a central office.

**Data Link Connection Identifier (DLCI):** One of the six components of a frame relay frame. Its purpose is to distinguish separate virtual circuits across each access connection. Data coming into a frame relay node is thus allowed to be sent across the interface to the specified "address". The DLCI is confirmed and relayed to its destination, or if the specification is in error, the frame is discarded.

**Dataphone Digital Service (DDS):** A private line digital service that offers 2400, 4800, 9600 and 56 Kbps data rates on an inter-LATA basis by AT&T and on an intra-LATA basis by the BOCs.

**Data Service Unit (DSU):** A device that provides a digital data service interface directly to the data terminal equipment. The DSU provides loop equalization, remote and local testing capabilities, and a standard EIA/CCITT interface.

**Dedicated Line:** A communication line that is not switched. The term leased line is more common.

**Default:** This is a preset value or option in software packages, or in hardware configuration, that is used unless you specify otherwise.

**Device driver:** Software that controls how a computer communicates with a device, such as a printer or mouse.

**Digital Cross-connect System (DCS):** The CO device which splits and redistributes the T1 bandwidth. The DCS takes time slots from various T1 lines and alters them to provide the needed connectivity. DCS connections are made with software at an administrator's workstation.

**Digital Data:** Information represented by discrete values or conditions (contrast "Analog Data").

**Digital Loopback:** A technique used for testing the circuitry of a communications device. Can be initiated locally, or remotely (via a telecommunications device). The tested device decodes and encodes a received test message, then echoes the message back. The results are compared with the original message to determine if corruption occurred en route.

**Digital PBX:** A Private Branch Exchange that operates internally on digital signals. See also "Exchange".

**Digital Service, level 0 (DS0):** The worldwide standard speed (64 Kbps) for digital voice conversation using PCM (pulse coded modulation).

**Digital Service, level 1 (DS1):** The 1.544M bps voice standard (derived from an older Bell System standard) for digitized voice transmission in North America. The 1.544M bps consists of 24 digitally-encoded 64 Kbps voice channels (north America) and 2.048M bps (30 channels) elsewhere.

**Digital Signal:** A discrete or discontinuous signal (e.g., a sequence of voltage pulses). Digital devices, such as terminals and computers, transmit data as a series of electrical pulses which have discrete jumps rather than gradual changes.

**Digital Signaling Rates (DSn):** A hierarchical system for transmission rates, where "DS0" is 64 Kbps (equivalent to ISDN B channel), and DS1 is 1.5 Mbps (equivalent to ISDN PRI).

**Digital Transmission:** A method of electronic information transmission common between computers and other digital devices. Analog signals are waveforms: a combination of many possible voltages. A computer's digital signal may be only "high" or "low" at any given time. Therefore, digital signals may be "cleaned up" (noise and distortion removed) and amplified during transmission.

**Digitize:** To convert an analog signal to a digital signal.

**DIP switch (pronounced "dip switch"):** A set of tiny toggle switches, built into a DIP (dual in-line package), used for setting configurable parameters on a PCB (printed circuit board).

**Driver:** A software module that interfaces between the Operating System and a specific hardware device (e.g., color monitors, printers, hard disks, etc.). Also known as a device driver.

**Drop and Insert:** The process where a portion of information carried in a transmission system is demodulated ("Dropped") at an intermediate point and different information is included ("Inserted") for subsequent transmission.

**DTE (Data Terminal Equipment):** A term used to include any device in a network which generates, stores or displays user information. DTE is a telecommunications term which usually refers to PCs, terminals, printers, etc.

**DTMF (Dual-Tone MultiFrequency):** A generic push-button concept made popular by AT&T TouchTone.

## E

**E&M:** A telephony trunking system used for either switch-to-switch, or switch-to-network, or computer/telephone system-to-switch connection.

**EIA:** The Electronics Industries Association is a trade organization in Washington, DC that sets standards for use of its

member companies. (See RS-232, RS-422, RS530.)

**Encapsulation:** A technique used by network-layer protocols in which a layer adds header information to the protocol data unit from the preceding layer. Also used in “enveloping” one protocol inside another for transmission. For example, IP inside IPX.

**Errored Seconds (ES):** Any second of operation that all 1.544M bits are not received exactly as transmitted. Contrast “Error Free Seconds”.

**Error Free Seconds (EFS):** Any second of operation that all 1.544M bits are received exactly as transmitted. Contrast “Errored Seconds”.

**ESF Error Event:** A T1 error condition that is logged when a CRC-6 error or an out-of-frame (OOF) error occurs.

**Ethernet:** A 10-megabit baseband local area network that allows multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and transmission. Ethernet uses carrier sense multiple access with collision detection (CSMA/CD).

**Excess Zeros:** A T1 error condition that is logged when more than 15 consecutive 0s or fewer than one 1 bit in 16 bits occurs.

**Exchange:** A unit (public or private) that can consist of one or more central offices established to serve a specified area. An exchange typically has a single rate of charges (tariffs) that has previously been approved by a regulatory group.

**Exchange Area:** A geographical area with a single uniform set of charges (tariffs), approved by a regulatory group, for telephone services. Calls between any two points within an exchange area are local calls. See also “Digital PBX”, “PBX”.

**Exchange Termination (ET):** The carrier’s local exchange switch. Contrast with “Loop Termination - LT”.

**Explicit Congestion Management:** The method used in frame relay to notify the terminal equipment that the network is overly busy. The use of FECN and BECN is called explicit congestion management. Some end-to-end protocols use FECN or BECN, but usually not both options together. With this method, a congestion condition is identified and fixed before it becomes critical. Contrast with “implicit congestion”.

**Extended Super Frame (ESF):** One of two popular formats for framing bits on a T1 line. ESF framing has a 24-frame super-frame, where robbed bit signaling is inserted in the LSB (bit 8 of the DS-0 byte) of frames 6, 12, 18 and 24. ESF has more T1 error measurement capabilities than D4 framing. Both ESF and B8ZS are typically offered to provide clear channel service.

## F

**Failed Seconds:** A test parameter where the circuit is unavailable for one full second.

**Failed Signal:** A T1 test parameter logged when there are more than 9 SES (Severely Errored Seconds).

**Fax (facsimile):** Refers to the bit-mapped rendition of a graphics-oriented document (fax) or to the electronic transmission of the image over telephone lines (faxing). Fax transmission differs from data transmission in that the former is a bit-mapped approximation of a graphical document and, therefore, cannot be accurately interpreted according to any character code.

**Firmware:** A category of memory chips that hold their content without electrical power, they include ROM, PROM, EPROM and EEPROM technologies. Firmware becomes “hard software” when holding program code.

**Foreground:** The application program currently running on and in control of the PC screen and keyboard. The area of the screen that occupies the active window. Compare with “background”.

**Fractional T1 (FT1):** A digital data transmission rate between 56 Kbps (DS0 rate) and 1.544M bps (the full T1 rate - in North America). FT1 is typically provided on 4-wire (two copper pairs) UTP. Often used for video conferencing, imaging and LAN interconnection due to its low cost and relatively high speed. FT1 rates are offered in 64 Kbps multiples, usually up to 768 Kbps.

**Frequency:** A characteristic of an electrical or electronic signal which describes the periodic recurrence of cycles. Frequency is inversely proportional to the wavelength or pulse width of the signal (i.e., long wavelength signals have low frequencies and short wavelength signals yield high frequencies).

**Foreign Exchange (FX):** A CO trunk with access to a distant CO, allowing ease of access and flat-rate calls anywhere in the foreign exchange area.

**Foreign Exchange Office (FXO):** provides local telephone service from a CO outside of (“foreign” to) the subscriber’s exchange area. In simple form, a user can pick up the phone in one city and receive a tone in the foreign city. Connecting a POTS telephone to a computer telephony system via a T1 link requires a channel bank configured for the FX connection. To generate a call from the POTS set to the computer telephony system, a FXO connection must be configured.

**Foreign Exchange Station (FXS):** See FX, FXO. To generate a call from the computer telephony system to the POTS set, an FXS connection must be configured.

**Forward Explicit Congestion Notification (FECN):** A bit that tells you that a certain frame on a particular logical connection has encountered heavy traffic. The bit provides notification that congestion-avoidance procedures should be initiated in the same direction of the received frame. See also BECN (Backward Explicit Congestion Notification).

**Frame:** A group of data bits in a specific format to help network equipment recognize what the bits mean and how to process them. The bits are sent serially, with a flag at each end signifying the start and end of the frame.

**Frame Relay:** A form of packet switching that uses small packets and that requires less error checking than other forms of packet switching. Frame relay is effective for sending “bursty” data at high speeds (56/64K, 256K, and 1024 Kbps) over wide area networks. Frame Relay specifications are defined by ANSI documents ANSI T1.602, T1.606, T1S1/90-175, T1S1/90-213, and T1S1/90-214. In using frame relay, blocks of information (frames) are passed across a digital network interface using a “connection number” that is applied to each frame to distinguish between individual frames.

**Frame Relay Forum:** A nonprofit organization of 300+ vendors and service providers, based in Foster City, CA, that are developing and deploying frame relay equipment.

**Frame Relay Implementors Forum:** A group of companies supporting a common specification for frame relay connection to link customer premises equipment to Telco network equipment. Their specification supports ANSI frame relay specs and defines extensions such as local management.

**Frame Relay Access Device (FRAD):** A piece of equipment that acts as a concentrator or frame assembler/ dissassembler that can support multiple protocols and provide basic “routing” functions.

## G

**Gateway:** 1. A functional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architectures. 2. A network that connects hosts.

**Graphical User Interface (GUI):** A type of computer interface consisting of a visual metaphor of a real-world scene, often of a desktop. Within that scene are icons, representing actual objects, that the user can access and manipulate with a pointing device.

## H

**Handshaking:** A process that two modems go through at the time of call setup to establish synchronization over the data communications link. It is a synchronization and negotiation process accomplished by the exchange of predefined, mutually recognized control codes.

**High-level Data Link Control (HDLC):** An ISO standard, bit-oriented data communications protocol that provides nearly error-free data transfers.

## I

**Hexadecimal:** A base 16 numbering system used to represent binary values. Hex uses the numbers 0-9 and the letters A-F: usually notated by an “h” (e.g., “4CF h”, read “four charley fox, hex”). The result is that one hex digit represents a 4-bit value.

**Implicit congestion management:** A method of informing the terminal that the network is busy. This method relies on the end-system protocol to detect and fix the congestion problem. (TCP/IP is an example of a protocol using only implicit congestion management.) See also “explicit congestion management”.

**In-band:** Refers to the type of signalling over the conversion path on an ISDN call. Contrast “out-of-band”.

**Insufficient Ones:** A T1 error condition that is logged when fewer than one 1 in 16 0s or less than 12.5 % average 1s density is received.

**Inter Exchange Carrier (IEC):** The long distance company (LE) whose central office provides the point of reference for T1 access. Any common carrier authorized by the FCC to carry customer transmissions between LATAs.

**Internet:** Refers to the computer network of many millions of university, government and private users around the world. Each user has a unique Internet Address.

**Internet Address (IP Address):** A unique 32-bit address for a specific TCP/IP host on a network. Normally printed in dotted decimal format (e.g., 129.128.44.227).

**Internet Protocol (IP):** A protocol used to route data from its source to its destination in an Internet environment. The Internet Protocol was designed to connect local area networks. Although there are many protocols that do this, IP refers to the global system of interconnecting computers. It is a highly distributed protocol (each machine only worries about sending data to the next step in the route).

**Internetwork Packet Exchange (IPX):** A NetWare communications protocol used to route messages from one node to another. IPX packets include network addresses and can be routed from one network to another. An IPX packet can occasionally get lost when crossing networks, thus IPX does not guarantee delivery of a complete message. Either the application has to provide that control, or NetWare's SPX protocol must be used.

**Interoperable:** Devices from different vendors that can exchange information using a standard's base protocol.

**I/O Addresses:** Locations within the I/O address space of your computer used by a device, such as an expansion card, a serial port, or an internal modem. The address is used for communication between software and a device.

**IRQ Level (Interrupt Request Level):** The notification a processor receives when another portion of the computer's hardware requires its attention. IRQs are numbered so that the device issuing the IRQ can be identified, and so IRQs can be prioritized.

**ISA (Industry Standards Architecture) (pronounced "ice a"):** The classic 8 or 16-bit architecture introduced with IBM's PC-AT computer.

**ISDN (Integrated Services Digital Network):** An International telecommunications standard for transmitting voice, video and data over a digital communications line. ISDN is a worldwide telecommunications service that uses digital transmission and switching technology to support voice and digital data communications. Frame relay was partially based on ISDN's data link layer protocol (LAPD). Frame relay can be used to transmit across ISDN services offering circuit-switched connection at 64 Kbps and higher speeds. Contrast Public Switched Telephone Network (PSTN).

**ITU-TSS (formerly CCITT):** International Telecommunications Union-Telecommunications Sector; the United Nations organization that prepares standards ("Recommendations") for resolving communications issues and problems.

## J

No Entries.

## K

**Key Telephone System (KTS):** Phone devices with multiple buttons that let you select incoming or outgoing CO phone lines directly. Similar in operation to a PBX, except with a KTS you don't have to dial a "9" to call outside the building.

**Key Service Unit (KSU):** A small device containing the switching electronics for a business key telephone system (KTS).

**Key Set:** A telephone set with several buttons for call holding, line pickup, intercom, autodialing, etc. Also called a Touch-Tone phone (Ericsson) and a KTS (Key Telephone Set).

## L

**LAPB:** Link Access Procedure Balanced; based on the X.25 Layer 2 specification. A full-duplex, point-to-point, bit-synchronous protocol commonly used as a data link control protocol to interface X.25 DTEs. LAPB is the link initialization procedure that establishes and maintains communications between the DTE and the DCE.

**LAPD:** Link Access Protocol for the D-Channel; based on the ISDN Q.921 specification. A full-duplex point-to-point bit-synchronous link-level protocol for ISDN connections; different from LAPB in its framing sequence. Transmission is in units called "frames", and a frame may contain one or more X.25 packets.

**Line Coding:** The representation of 1s and 0s on a T1 line. The two methods of line coding commonly used, B8ZS and AMI, differ in the restrictions placed on user data. T1 line coding ensures that sufficient timing information is sent with the digital signal to ensure recovery of all the bits at the far end. Timing information on the T1 line is included in the form of 1s in the data stream; a long string of 0s in the data stream could cause problems recovering the data.

**Line Termination (LT):** The electronics at the ISDN network side of the user/network interface that complements the NT1 at the user side. The LT and the NT1 together provide the high-speed digital line signals required for BRI access.

**Listed Directory Number (LDN):** The main number assigned by the Telco; the number listed in the telephone directory and also provided by Directory Assistance. Some devices can have more than one LDN, such as ISDN devices that have one LDN for voice and another LDN for data.

**Local Area Network (LAN):** 1. A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. 2. A LAN does not use store-and-forward techniques. 3. A network in which a set of devices are connected to one another for a communication and that can be connected to a larger network.

**Local Access and Transport Area (LATA):** A post-divestiture geographical area generally equivalent to a Standard Metropolitan Statistical Area. At divestiture, the territory served by the Bell system was divided into approximately 161 LATAs. The Bell Operating Companies (BOCs) provide Intra-LATA services.

**Local Exchange Carrier (LEC):** The local phone company which provides local (i.e., not long distance) transmission

services. aka “Telco”. LECs provide T1 or FT1 access to LDCs (unless the T1 circuit is completely intra-LATA). Inter-LATA T1 circuits are made up of a combination of Access and Long Haul facilities.

**Local Management Interface (LMI):** A specification for frame relay equipment that defines status information exchange.

**Local Loop:** A transmission path, typically twisted-pair wire, between an individual subscriber and the nearest public telecommunications network switching center. The wires provide ISDN service, but require an NT1 at the user end and an LT at the network end. (AKA, “loop” or “subscriber loop”.)

**Logical Link Control (LLC2):** In a local area network, the protocol that governs the exchange of transmission frames between data stations independently of how the transmission medium is shared. The LLC2 protocol was developed by the IEEE 802 committee and is common to all LAN standards.

**Logical Unit (LU):** A type of network accessible unit that enables end users to gain access to network resources and communicate with each other.

**Long Haul:** The T1 element that connects to the Access portion of the long distance company’s (LDC’s) central office. The LDC is commonly called the point of presence (POP). Each LDC has a number of POPs, located throughout the country. The LDC is also called an IEC (Inter Exchange Carrier).

**Long Haul Communications:** The type of phone call reaching outside of a local exchange (LE).

## M

**Management Information Base (MIB):** A database of network management information used by the Common Management Information Protocol (CMIP) and the Simple Network Management Protocol (SNMP).

**Megacom:** An AT&T service with a normal WATS line (typically T1) between the customer premise and the AT&T serving class 4 CO are the customer’s responsibility.

**MegaLink:** BellSouth’s leased T1 service.

**Message:** Associated with such terms as packet, frame, and segment. 1. In information theory, an ordered series of characters intended to convey information. 2. An assembly of characters and sometimes control codes that is transferred as an entry from an originator to one or more recipients.

**Modem:** A communications device that enables a computer to transmit information over a telephone line. It converts the computer’s digital signals into analog signals to send over a telephone line and converts them back to digital signals at the receiving end. Modems can be internal and fit into an expansion slot, or external and connect to a serial port.

**Multiplexer (Mux):** 1. A device that takes several input signals and combines them into a single output signal in such a manner that each of the input signals can be recovered. 2. A device capable of interleaving the events of two or more activities or capable of distributing the events of an interleaved sequence to the respective activities. 3. Putting multiple signals on a single channel.

**Multiprotocol:** A device that can interoperate with devices utilizing different network protocols.

**MultiRouter:** A secure gateway that provides multiple LAN users with high performance Internet access by functioning as a TCP/IP MultiRouter that resides on the outer edge of a firewall.

**Multithreading:** The ability of a software system to be able to handle more than one transaction concurrently. This is contrasted to the case where a single transaction is accepted and completely processed before the next transaction processing is started.

## N

**Nailed Connection:** A permanent or dedicated circuit of a previously switched circuit or circuits.

**Nailed-up Circuit:** A semipermanent circuit established through a circuit-switching facility for point-to-point connectivity.

**NAK (Negative Acknowledgment):** Communications code used to indicate that a message was not properly received, or that a terminal does not wish to transmit. Contrast with ACK.

**Network:** A group of computers connected by cables or other means and using software that enables them to share equipment, such as printers and disk drives to exchange information.

**Node:** Any point within a network which has been assigned an address.

## O

**Object-Oriented:** A method for structuring programs as hierarchically organized classes describing the data and operations of objects that may interact with other objects.

**Office Channel Unit - Data Port (OCU-DP):** The CO channel bank used as the interface between the customer’s DSU and the channel bank.

**Off-hook:** The condition of a device which has accessed a phone line (with or without using the line). In modem use, this is equivalent to a telephone handset being picked up. Dialing and transmission are allowed, but incoming calls are not answered. Contrast “on-hook”.

**Off Premise Extension (OPX):** An extension or phone that terminates in a location other than that of the PBX. Commonly used to provide a corporate member with an extension of the PBX at home.

**Ones Density:** the measure of the number of logical 1s on a T1 line compared to a given total number of bits on that line; used for timing information in data recovery in AMI and B8ZS.

**On-Hook:** The condition of a device which has not accessed a phone line. In modem use, this is equivalent to a telephone handset that has not been picked up. In other words, it can receive an incoming call. Contrast “off-hook”.

**Open Shortest Path First (OSPF):** A hierarchical Interior Gateway Protocol (IGP) routing algorithm for IP that is a proposed standard for the Internet. OSPF incorporates least-cost routing, equal-cost routing, and load balancing.

**Outage:** The measure of the time during which a circuit is not available for use due to service interrupt. Outage is the complement of circuit “availability” (100% minus % available = % outage).

**Out-of-band:** Signaling that is separated from the channel carrying the information (e.g., the voice/data/video signal is separate from the carrier signal). Dialing and various other “supervisory” signals are included in the signaling element. Contrast “In-band” signaling.

**Out of Frame (OOF):** A T1 alarm condition that is logged on the loss of 2, 3 or 4 of 5 consecutive FT framing bits.

## P

**Packet:** 1. In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. The data, control signals and, possibly, error control information are arranged in a specific format. 2. Synonymous with data frame. 3. In TCP/IP, the unit of data passed across the interface between the Internet layer and the link layer. A packet includes an IP header and data. A packet can be a complete IP datagram or a fragment of an IP diagram. 4. In X.25, a data transmission information unit. A group of data and control characters, transferred as a unit, determined by the process of transmission. Commonly used data field lengths in packets are 128 or 256 bytes. 5. The field structure and format defined in the CCITT X.25 recommendation.

**Packet Assembler/Dissembler (PAD):** Used by devices to communicate over X.25 networks by building or stripping X.25 information on or from a packet.

**Packet Data:** The information format (“packetized”) used for packet-mode calls.

**Packet Mode:** Refers to the switching of chunks of information for different users using statistical multiplexing to send them over the same transmission facility.

**Parity bit:** An extra bit attached to each byte of synchronous data used to detect errors in transmission.

**Permanent Virtual Circuit (PVC):** A connection between two endpoints dedicated to a single user. In ISDN, PVCs are established by network administration and are held for as long as the user subscribes to the service.

**Physical Unit (PU):** The component that manages and monitors the resources (such as attached links and adjacent link stations) associated with a node, as requested by an SSCP via an SSCP-PU session. An SSCP activates a session with the physical unit in order to indirectly manage, through the PU, resources of the node such as attached links. This term applies to type 2.0, type 4, and type 5 nodes only.

**Point of Presence (POP):** The central office’s end points of the long distance carriers.

**Point-to-Point Protocol (PPP):** A protocol that lets a PC user access TCP/IP (Internet member) using an ISDN terminal adapter or a high-speed modem over a standard telephone line.

**Port:** A location for input or output data exchange. Computers, muxes, etc. have ports for various purposes.

**Primary Rate Interface (PRI):** Used on ISDN. In North America, and Japan, PRI is one 64 Kbps D channel and 23 B channels. Elsewhere, it is one D channel and 30 B channels.

**Primitive:** An abstract representation of interaction across the access points indicating that information is being passed between the service user and the service provider. The OSI Reference Model defines four types of primitives: Request, Indication, Response and Confirm.

**Private Branch Exchange (PBX):** A telephone exchange located on the customer’s premises. The PBX provides a circuit switching facility for telephone extension lines within the building, and access to the public telephone network. See also “Exchange”.

**PROM (Programmable Read Only Memory - pronounced “prom”):** A permanent memory chip that can be programmed or filled by the customer after by the manufacturer has set initial values. Contrast with ROM.

**Protocol:** 1. A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. 2. In Open Systems Interconnection architecture, a set of semantic and syntactic rules that determine

the behavior of entities in the same layer in performing communication functions. 3. In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. 4. Synonymous with line control discipline.

**PSTN (Public Switched Telephone Network):** A worldwide public voice telephone network that is used as a telecommunications medium for the transmission of voice, data and other information.

**Public Data Network (PDN):** A packet-switched network that is available to the public for individual ("subscriber") use. Typically, controlled by a government or a national monopoly.

**Public Switched Telephone Network (PSTN):** The group of circuit-switching voice carriers, which are commonly used as analog data communications services.

**Pulse Code Modulation (PCM):** 1. In data communication, variation of a digital signal to represent information; for example, by means of pulse amplitude modulation (PAM), pulse duration modulation (PDM), or pulse position modulation (PPM). 2. Transmissions of analog information in digital form through sampling and encoding the samples with a fixed number of bits.

**Pulse dialing:** One of two methods of dialing a telephone, usually associated with rotary-dial phones. Compare with "tone dialing".

## Q

**Quantizing:** The process of analog-to-digital conversion by assigning a range, from the contiguous analog values, to a discrete number.

## R

**Random Access Memory (RAM):** A computer's primary work space. All data must be stored in RAM (even for a short while), before software can use the processor to manipulate the data. Before a PC can do anything useful it must move programs from disk to RAM. When you turn it off, all information in RAM is lost.

**Rate Enforcement:** The concept in frame relay where frames sent faster than the CIR are to be carried only if the bandwidth is available, otherwise they are to be discarded. (The frame relay network assumes that anything exceeding the CIR is of low priority.) Rate enforcement makes sure that the network will not get so congested that it isn't able to meet the agreed on CIR.

**Recognized Private Operating Agency (RPOA):** A corporation, private or government-controlled, that provides telecommunications services. RPOAs, such as AT&T, participate as nonvoting members in the CCITT.

**Red Alarm:** A T1 error condition generated when a local failure (e.g., loss of synchronization) exists for 2.5 seconds, causing a Carrier Group Alarm (CGA). See also "Blue Alarm" and "Yellow Alarm".

**Request for Comment (RFC):** A set of papers in which Internet standards (published and proposed), along with generally-accepted ideas, proposals, research results, etc. are published.

**Ring Down Box:** A device that emulates a CO by generating POTS calls for testing and product demos.

**Ring Down Circuit:** A tie line connecting phones where picking up one phone automatically rings another phone. A feature used for emergencies to alert the person at the other phone of the incoming call.

**RJ-11:** An industry standard interface used for connecting a telephone to a modular wall outlet; comes in 4- and 6-wire packages.

**RJ-45:** An 8-wire modular connector for voice and data circuits.

**Robbed Bit Signaling:** The popular T1 signaling mechanism where the A and B bits are sent by each side of the T1 termination and are "buried" in the voice data of each voice channel in the T1 circuit. Since the bits are "robbed" infrequently, voice quality remains relatively uncompromised. See "bit robbing". The robbed-bit signaling technique is used in D4 channel banks to convey signaling information. The eighth (least significant) bit of each of the 24 8-bit time slots is "robbed" every sixth frame to convey voice-related signaling information such as on-hook, off-hook, etc., for each channel.

**Router:** A device that connects two networks using the same networking protocol. It operates at the Network Layer (Layer 3) of the OSI model for forwarding decisions.

**Routing Information Protocol (RIP):** A distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

**RS232-C:** An EIA standard for a serial interface between computers and peripheral devices (modem, mouse, etc.). It uses a 25-pin DB-25, or a 9-pin DB-9 connector. The RS-232 standard defines the purposes, electrical characteristics and timing of the signals for each of the 25 lines.

**RS-422:** The EIA standard for a balanced interface with no accompanying physical connector. RS-422 products can use screw terminals, DB9, various DB25, and DB37 connectors.

**RS-530:** The EIA standard for the mechanical/electrical interface between DCEs and DTEs transmitting synchronous or asynchronous serial binary data. RS-530 provides for high data rates with the same connector used for RS-232; however, it is incompatible with RS-232.

## S

**Serial Port:** The connector on a PC used to attach serial devices (those that need to receive data one bit after another), such as a mouse, a printer or a modem. This consists of a 9- or 25-pin connector that sends data in sequence (bit by bit). Serial ports are referred to as “COMx” ports, where x is 1 to 4 (i.e., COM1 through COM4). A serial port contains a conversion chip called a “UART” which translates between internal parallel and external serial formats.

**Service:** The requirements offered by an RPOA to its customers to satisfy specific telecommunications needs.

**Severely Errored Seconds (SES):** Refers to a typical T1 error event where an error burst occurs (a short term, high bit-error rate that is self-clearing). Per the ITU-T (CCITT) G.821: any second in which the BER is less than 1x10 -3 .

**Signaling:** The process of establishing, maintaining, accounting for, and terminating a connection between two endpoints (e.g., the user premises and the Telco CO). Central office signals to the user premises can include ringing, dial tone, speech signals, etc. Signals from the user’s telephone can include off-hook, dialing, speech to far-end party, and on-hook signals. In-band signaling techniques include pulse and tone dialing. With common channel signaling, information is carried out-of-band.

**Simple Network Management Protocol (SNMP):** TCP/IP protocol that allows network management.

**Simultaneous Voice Data (SVD):** A technology for letting a user send data via a modem, and use a handset to talk to another user at the same time over the same connection. The alternative, making a second call, can be expensive or even impossible. The uses for SVD are telecommuting, videoconferencing, distant learning, tech support, etc.

**Stop Bit:** One of the variables used for timing in asynchronous data transmission. Depending on the devices, each character may be trailed by 1, 1.5, or 2 stop bits.

**Superframe (D4):** A T1 transmission format that consists of 12 DS1 frames, or 2316 bits. A DS1 frame consists of 193 bit positions. A frame overhead bit is in the first position, and it is used for frame and signaling phase alignment only.

**Subscriber Loop:** See “Local loop”.

**Switched 56:** A circuit-switched (full duplex digital synchronous data transmission) service that lets you dial a number and transmit data to it at 56 Kbps. It is a relatively low cost service, widely used in North America for telecommuting, videoconferencing and high speed data transfers. Many phone companies are (or will be) phasing out Switched 56 in favor of ISDN service.

**Switched Virtual Circuit (SVC):** A type of data transmission where the connection is maintained only until the call is cleared.

**Switched Line:** In communications, a physical channel established by dynamically connecting one or more discrete segments. This connection lasts for the duration of the call, after which each segment can be used as part of a different channel. Contrast with leased line.

**Switched Network:** A network in which a temporary connection is established from one point via one or more segments.

**Synchronous Data Link Control (SDLC):** A discipline conforming to subsets of the Advanced Data Communications Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex, or half-duplex over switched or non-switched links. The configuration of the link connection may be point-to-point, multipoint, or loop.

**Synchronous Transmission:** The transmission of data which involves sending a group of characters in a packet. This is a common method of transmission between computers on a network or between modems. One or more synchronous characters are transmitted to confirm clocking before each packet of data is transmitted. Compare to Asynchronous Transmission.

**Systems Network Architecture (SNA):** The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks.

## T

**Tariff:** The rate/availability schedule for telephone and ISDN services from a regulated service provider.

**TCP/IP:** A set of communication protocols that support peer-to-peer connectivity functions for both local and wide area networks.

**T Carrier:** The generic name for a digitally multiplexed carrier system. In the North American digital hierarchy, a T is used to designate a DS (digital signal) level hierarchy. Examples: T1 (DS1) is a 1.544 Mbps 24-channel designation. In

Europe, T1 is called E1. The T Carrier system was originally designed for transmitting digitized voice signals, but has since been adapted for digital data applications.

**T1:** A digital transmission link capable of 1.544 Mbps. T1 uses two pairs of normal UTP, and can handle 24 voice conversations, each digitized at 64 Kbps. T1 is a standard for digital transmission in the U.S., Canada, Japan and Hong Kong. T1 is the access method for high-speed services such as ATM, frame relay, and SMDS. See also T Carrier, T1 line and FT1.

**T1 Channel Tests:** A set of diagnostics that vary by carrier, used to verify a T1 channel operation. Can include Tone, Noise Level, Impulse Noise Level, Echo Cancelers, Gain, and Crosstalk testing.

**T1 Framing:** To digitize and encode analog voice signals requires 8000 samples per second (twice the highest voice frequency of 4000 Hz). Encoding in an 8-bit word provides the basic T1 block of 64 Kbps for voice transmission. This "Level 0 Signal, as its called, is represented by "DS-0", or Digital Signal at Level 0. 24 of these voice channels are combined into a serial bit stream (using TDM), on a frame-by-frame basis. A frame is a sample of all 24 channels; so adding in a framing bit gives a block of 193 bits (24x8+1=193). Frames are transmitted at 8000 per second (the required sample rate), creating a 1.544M (8000x193=1.544M) transmission rate.

**T1 Line:** A digital communications facility that functions as a 24-channel pathway for data or voice transmission. A T1 line is composed of two separate elements: the Access element and the Long Haul element.

**T1 Mux:** A device used to carry many sources of data on a T1 line. The T1 mux assigns each data source to distinct DS0 time slots within the T1 signal. Wide bandwidth signals take more than one time slot. Normal voice traffic or 56/64 Kbps data channels take one time slot. The T1 mux may use an internal or external T1 DSU; a "channel bank" device typically uses an external T1 CSU.

**Transmission Control Protocol / Internet Program (TCP/IP):** A multilayer set of protocols developed by the US Department of Defense to link dissimilar computers across dissimilar and unreliable LANs.

**Terminal:** The screen and keyboard device used in a mainframe environment for interactive data entry. Terminals have no "box", which is to say they have no file storage or processing capabilities.

**Terminal Adapter (TA):** An ISDN DTE device for connecting a non-ISDN terminal device to the ISDN network. Similar to a protocol converter or an interface converter, a TA connects a non-ISDN device between the R and S interfaces. Typically a PC card.

**Tie line:** A dedicated circuit linking two points without having to dial a phone number (i.e., the line may be accessed by lifting the telephone handset or by pushing a button).

**Time-Division Multiplexing (TDM):** Division of a transmission facility into two or more channels by allotting the common channel to several different information channels, one at a time.

**Time Slot:** One of 24 channels within a T1 line. Each channel has a 64 Kbps maximum bandwidth. "Time slot" implies the time division multiplexing organization of the T1 signal.

**Toll Call:** A call to a location outside of your local service area (i.e., a long distance call).

**Tone dialing:** One of two methods of dialing a telephone, usually associated with Touch-Tone® (push button) phones. Compare with pulse dialing.

**Topology:** Physical layout of network components (cables, stations, gateways, and hubs). Three basic interconnection topologies are star, ring, and bus networks.

**Transmission Control Protocol (TCP):** A communications protocol used in Internet and in any network that follows the US Department of Defense standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communications networks and in interconnected systems of such networks. It assumes that the Internet protocol is the underlying protocol.

**Transport Layer:** Layer 4 of the Open Systems Interconnection (OSI) model; provides reliable, end-to-end delivery of data, and detects transmission sequential errors.

**Transport Protocol Data Unit (TPDU):** A transport header, which is added to every message, contains destination and source addressing information that allows the end-to-end routing of messages in multilayer NAC networks of high complexity. They are automatically added to messages as they enter the network and can be stripped off before being passed to the host or another device that does not support TPDU's.

**Trunk:** Transmission links that interconnect switching offices.

**TSR (terminate and stay resident):** A software program that remains active and in memory after its user interface is closed. Similar to a daemon in UNIX environments.

**Tunneling:** Encapsulation data in an IP packet for transport across the Internet.

**Twisted pair wiring:** A type of cabling with one or more pairs of insulated wires wrapped around each other. An inexpensive wiring method used for LAN and telephone applications, also called UTP wiring.

## U

**UART (Universal Asynchronous Receiver/Transmitter) (pronounced “you art”):** A chip that transmits and receives data on the serial port. It converts bytes into serial bits for transmission, and vice versa, and generates and strips the start and stop bits appended to each character.

**UNIX:** An operating system developed by Bell Laboratories that features multiprogramming in a multi-user environment.

**Unshielded Twisted Pair (UTP):** Telephone-type wiring. Transmission media for 10Base-T.

## V

**V.25bis:** An ITU-T standard for synchronous communications between a mainframe or host and a modem using HDLC or other character-oriented protocol.

**V.54:** The ITU-T standard for local and remote loopback tests in modems, DCEs and DTEs. The four basic tests are:

- local digital loopback (tests DTE send and receive circuits),
- local analog loopback (tests local modem operation),
- remote analog loopback (tests communications link to the remote modem), and
- remote digital loopback (tests remote modem operation).

**Virtual Circuit:** A logical connection. Used in packet switching wherein a logical connection is established between two devices at the start of transmission. All information packets follow the same route and arrive in sequence (but do not necessarily carry a complete address).

## W

**Wide Area Network (WAN):** 1. A network that provides communication services to a geographic area larger than that served by a local area network or a metropolitan area network, and that may use or provide public communication facilities. 2. A data communications network designed to serve an area of hundreds or thousands of miles; for example, public and private packet-switching networks, and national telephone networks. Contrast with local area network (LAN).

**Wide Area Telecommunications Service (WATS):** A low-cost toll service offered by most long distance and local phone companies. Incoming (800 call service, or IN-WATS) and outgoing WATS are subscribed to separately, but over the same line.

## X

**X.25:** ITU-T’s definition of a three-level packet-switching protocol to be used between packet-mode DTEs and network DCEs. X.25 corresponds with layer 3 of the 7-layer OSI model.

## Y

**Yellow Alarm:** An error indication sent by the T1 device when it has not gotten a receive signal, or cannot synchronize on the receive signal received. Contrast “Red Alarm” and “Blue Alarm”.

## Z

**Zero Byte Time Slot Interchange (ZBTSI):** A method for allowing 64 Kbps unrestricted user data (allowing all 0s in the user data). An alternative to (but not as popular as) B8ZS.

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